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ABSTRACT

This symposium was a working meeting to develop an agenda for future action in education regarding videodisc technology. Following an introduction, three major presentations are provided: "An Introduction to Videodisc Technology" (Ronald W. Nugent); "Videodisc Applications and Implications for Education" (Orbry Holden); and "Planning Videodiscs in the Little Red Schoolhouse" (Ward Sybouts). Individual presentations on the use of videodiscs and research on their development and applications are then presented in 17 papers, which address such issues as the development of videodisc instructional programs; teacher preservice and inservice education in videodisc instruction; current uses of videodisc technology in public schools; interactive videodisc instructional programs in elementary classrooms, high school science, and university settings; use of interactive video to teach employment interview skills; and frameworks for examining and evaluating videodisc programs in public schools. Concluding remarks by John Prasch are also provided, as well as recommendations for a National Agenda for the Implementation of Videodisc and Laser Technology in Education; a brief description of the Second Annual Videodisc Symposium for Educators--Implementation of the Agenda to be held in October 1987, for which no proceedings have been published; and a list of the 1986 symposium participants. The text is supplemented by tables and figures, and seven of the 20 presentations include bibliographic references. (EW)

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PROCEEDINGS

NATIONAL VIDEODISC SYMPOSIUM FOR EDUCATION: A NATIONAL AGENDA

University of Nebraska-Lincoln
Lincoln, Nebraska
November 12-14, 1986

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NATIONAL VIDEODISC SYMPOSIUM FOR EDUCATION: A NATIONAL AGENDA

Edited by

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The National Videodisc Symposium for Education: A National Agenda

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SECTION I

INTRODUCTION

INTRODUCTION

With the growth patterns of technology in education, there has been the revelation that the linkage between the educational enterprise and inventors, designers, and producers of forms of technology, such as the videodisc, is a crucial one. Videodisc technology was not invented nor was it initially put into product form for education. The use of videodiscs for education came about through an adaptation process, as the potential for a technological device with the capability of storing and accessing extremely large quantities of information was made available to educators through the genius of people in technology.

A parallel might be drawn between videodisc technology and television (although the risk in doing so becomes apparent because of the obvious differences that exist between the two forms of technology). Television was focused on by commercial interests. Its potential was then seen by persons interested in educational applications. The growth and development of the television industry and all related electronic, promotional, and production industries grew as a result of commercialization of the technology. While television became a dominant factor in society as a whole, it has been much less dominant as a major influence in the direct process of educating the children and youth of the nation or in the education of adults, whether it be in formal or informal settings.

There has been and continues to be a considerable amount of debate about the influence of television upon the development of individuals in our society. There are also various and numerous interpretations about why television has been viewed by educators with a jaundiced eye of rejection. In many respects, television as a form of technology applicable for education has remained unfathomable and underused by the educational enterprise. Among the many and various reasons that can be identified for the limited use of television in education is the fact that education does not constitute a lucrative market segment for the total television industry. Consequently, societal resources have not been sufficiently allocated to the adaptation of television for educational purposes.

While the linkage between the television industry and education has a sufficient history to enable observers an opportunity to examine this relationship, its nature, and impact, not enough information regarding the linkage between videodisc technology and education has been generated to plot a trend. Consequently, the linkage between videodisc technology and education remains somewhat speculative. Even if the data base regarding the adaptation of technology to education were to be expanded beyond television to include lessons learned from observing what has happened in the last decade in regard to the adaptation of computer technology to education, there still remains debate.

Some observers feel the full adaptation of computers in education has reached a saturation point; others view what is before them and conclude that although the educational enterprise may have rather large numbers of computer hardware, the utilization of computer technology has not had much impact on the educational process nor upon measureable outcomes. After approximately a decade of microcomputer use in the schools and almost four decades of television experience, the use of technology in the classroom continues to be viewed with indecision, or at least with unresolved issues. It is only logical to ask the question, "What then is the future of videodisc technology in education and what are the issues that need to be addressed?"

There is an assumption that videodiscs hold within their technological grasp the ability to make a worthwhile contribution to education. Some educators are quite comfortable in accepting this assumption and investing in the development of software and the exploration of various applications. *If* videodisc technology does hold forth the potential that its advocates suggest, how should such a powerful form of technology be adapted and adopted into the classroom? Educators function in a bureaucracy within a complex society.

While the forces of change are continually awash on the shores of the establishment like

some restless tide, the educational establishment continues to reside with only limited changes eroding its shoreline. Through what channels and procedures must the change process take place if videodiscs are to become an integral and contributing part of the educational process?

The National Videodisc Users Symposium of 1986 was planned in order for interested persons to meet, display the current state of the art, and discuss developmental efforts in various segments of education and related agencies where videodiscs were being structured as an educational device. The proceedings of that conference are contained in the following pages. Vendors were able to display their wares, and those who had made adaptations and were exploring the utilization of videodiscs in educational settings were given the opportunity to make presentations. Some of those presentations are contained in Chapter III of these proceedings.

It was determined a working symposium that would bring participants together to discuss the question under the direction of opinion leaders in the field would be a viable approach to address the question of how videodisc technology would be introduced into the classroom. To accomplish this, a Task Force was identified, which consisted of specialists from industry and education who were interested in hardware, learning theory, or applications of videodiscs in education settings. The Task Force members represented a diverse range of interests and affiliations geographically and organizationally. During the Symposium, the responsibility of the Task Force members was to serve as group leaders for discussions which addressed the topic of how the introduction of videodiscs into education might be accomplished. The members were also asked as a group to synthesize some of the information generated in small group discussions held by participants of the Symposium. Finally, members of the Task Force were called upon for expert opinions and information about the entire range of topics under consideration.

Task Force members recognized the topic of "technology" in education in a broad sense, rather than a narrow focus on one form of technology such as the videodisc, was an option well worth considering. There is much to be said for the consideration of more than one form of technology. However, in light of the stage of development of videodiscs as an educational tool, it was concluded that at this time in the history of educational technology it was appropriate to direct the attention of Symposium participants on videodiscs.

The members of the Task Force and their affiliations are given below:

Tom Burnett, Assistant to the Superintendent for Computer Technology, Lincoln Public Schools, Lincoln, NE

Dr. Cynthia Chars, Research Scientist, Center for Children and Technology, Bank Street College of Education, New York, NY

Dr. Joe Clark, President, Videodiscovery, Seattle, WA

Dr. Orbry Holden, Executive Director, Texas Association of School Boards, Austin, TX

Dr. Alan Hofmeister, Vice President and Chief Scientist, Systems Impact Inc., Washington, D.C.

Dr. Larry Hutchins, Executive Director, Mid-Continent Regional Educational Laboratory, Aurora, CO

Dennis M. Kulvichi, Chairman, Public Teledelivery, Dickinson, TX

Dr. James Mecklenburger, Director, Institute for the Transfer of Technology to Education, National School Boards Association, Alexandria, VA

Ron Nugent, Director, Videodisc Design/Production Group, University of Nebraska-Lincoln, Lincoln, NE

Richard Pollak, Marketing Vice President, Minnesota Educational Computing Corporation, St. Paul, MN

John Prasch, Lecturer in Educational Administration, University of Nebraska-Lincoln, Lincoln, NE

John Rogers, Director ESU #3 Science Center, Omaha, NE

Dr. Dorothy Jo Stevens, Associate Professor of Curriculum and Instruction, University of Nebraska-Lincoln, NE

Dr. Ward Sybouts, Professor of Educational Administration, University of Nebraska-Lincoln, NE

SECTION II

MAJOR PRESENTATIONS

AN INTRODUCTION TO VIDEODISC TECHNOLOGY

Ronald W. Nugent

The first time I saw a videodisc, I thought, "There it is, that's what we've been looking for in educational media." As an instructional television producer, I had produced broadcast instructional television materials for about ten years before I first saw a disc. I had realized that one problem with broadcast instruction is its uncontrollability at the user stage. Cassettes and time shifting have helped, but what has always been needed is a product in public education that teachers could take and use as they saw fit. I want to quote Hofmeister's item V:

> Videodisc development should recognize the unique aspects of public instruction; for example, technological solutions borrowed from industry will not always recognize the central role of the teacher in the public school classroom. For many administrators staff development is just as important as student achievement. An instructional product that enhances both the skills of the teacher and the skills of the student within the same class structure, would be twice as valuable as a product that makes the teacher an equipment operator and does little to enhance the teacher's knowledge of effective instruction in a specific subject area. The flexibility of videodisc technology is one of its greatest strengths; such flexibility should be used to ensure the videodisc programs adapt the needs of public education. The unmodified transfer of programs or theoretical approaches from other areas of public schools do a disservice to the technology and public education.

I have never felt the only way to use a videodisc is in a $10,000 work station. A $10.000 work station is great for many things, but it is not necessary for everything, and is overkill for many applications. What is desirable is that teachers, the schools, and the students are given more control of the delivery of instruction. With this introduction, I want to go back to the beginning and talk about what a videodisc is and the various ways it can be used.

What Is the Videodisc?

The Optical Reflective Videodisc was invented by people who did not intend for it to be used by educators or that General Motors should use it for training. It was intended as a device to show movies in the home. It does that; however, the developers could not sell it for home movies. When the technologists examined it, they said, "Wow, you don't realize what you've done here folks. You can find any part on a disc in seconds, and you can stop and look at a single image indefinitely and that means you have the potential of getting 54,000 individual images on one side." That is what it is all about; it stores bits of information as stills or in motion on a medium you can access rapidly. The information can be used when it is wanted and how it is wanted.

A number of years ago, members of the Nebraska Videodisc Group found it useful to explain the various ways videodiscs could be used in terms of the characteristics of the discs and the players on which they are played. The two work together. The videodisc obviously has certain characteristics and will do certain things; however, the players are not all equal and the way they are used is not always the same. So we came up with a scheme called "Levels of Interactivity."

Let me back up and talk about the two formats in videodisc. There are two ways to pack the information on a disc: (1) constant linear velocity and (2) constant angular velocity. Constant linear velocity essentially

takes the same space for each image or picture that is on the disc; therefore, it is able to pack sixty minutes per side. In doing that, the ability to search out every individual frame is lost. Persons can still perform what is called "Chapter Searches," which I will discuss later. But, it is not possible to stop and search out every single part of the disc on a constant linear velocity disc.

Since the disc can pack sixty minutes per side, it is obviously useful for what are called linear presentations that basically play a few minutes or an hour of something without stopping it or accessing it at random. Constant angle velocity is the format most often used with videodisc instruction and training. In the constant angular velocity format each picture or image constitutes one revolution of the disc. Therefore, any part can be accessed for a single image to be scanned. The frame can be frozen indefinitely and result in a stable still image. For the most part, constant angular velocity (CAV) is used in educational applications; this gives only thirty minutes per side but allows easy access to all information.

Levels of Interactivity

The system that describes how the videodisc and its player work together and what can be done is called "Levels of Interactivity." It is important users understand about "levels" because that term has a very specific meaning in industry.

Level Zero is defined as Linear Play. The disc is started and it plays from point A to point B and stopped. In other words, movies or standard motion materials are examined.

Level One is a disc system that allows the user essentially manual random access. By using the player's keypad any point on the disc can be found by frame number. Every frame on a thirty-minute disc has its own discrete address, which can be found by doing a frame number search. Users also have two automatic functions that help in the use of a disc. One is called "Chapter Search," which is a way to put a code on the disc that the player can read and mark a section or chapter. The user may then call up or access sections by their chapter numbers. The other function is called "Picture Stop," which is a code that can be used to stop the disc automatically at a predetermined point. The disc will stop automatically at the head of a chapter or the tail end of a chapter. The teacher or student puts the disc on; it plays through the little segment and stops. One does not have to sit and anxiously wait for the exact moment; it stops and waits for an input.

Level Two can be described as a system in which the videodisc player is interfaced with a microprocessor that is part of the player. That processor or little computer can be programmed from the keypad if a person wishes to custom make his or her own presentation. More commonly, it is programmed automatically from what is called the digital dump on the disc.

The digital dump is nothing more complicated than a computer program on the disc itself; it programs the microprocessor that is part of the player to do whatever has been predesigned for that particular disc. Many things can be done with the digital dump, although the power and level of memory are low. The keypad in a Level Two system is generally used as an input device.

Level Three is very simple; it is any videodisc player under external computer control. Interface to the computer is via a standard port or with a control device that uses the remote control input of the videodisc player. More and more players are now made with the port built in; all that needs to be done to make the player a Level Three player is to connect it to a serial card or serial board on the computer. Level Three is any videodisc player under external computer control. Much can be done with a Level Three player; however, such players are more expensive due to the need for a computer to tie to the system and so on. It is much more complex to create the software, both the videodisc and control software. Basically, there is a move from a teacher-controlled environment to individualized instruction. The continuum from Level One through Level Three is valid; it depends on what is needed. All of Level Three is not needed to give teachers more resources to do certain things; however, it is needed if the

student is to be able to sit down one-on-one and do a preprogrammed exercise.

Equipment Options

The purchase of equipment can involve only a few hundred dollars up to several thousand depending on what the user wishes to accomplish. The simplest Level One players start at about $600. The Level Three system's basic player is approximately $1,800. There are package systems today that are in the $7,500 to $10,000 range for an up-scale, integrated work station. They are elegant and will do many things. It depends on what is needed. Many materials have been targeted for the Apple and a simple interface. Such a system, including the player and computer, is well under $2,500.

VIDEODISC APPLICATIONS AND IMPLICATIONS FOR EDUCATION

Orbry Holden

Introduction

When I go to the major funding groups, as a representative of the Texas Association of School Boards, the first question asked is, "Why are school boards interested in curriculum?" If the statistics of what happens at a school board meeting are examined, it is surprising how little time is spent on curriculum--less than five percent. I have maintained school board members are in the business of leadership. School board members have the role and responsibility to facilitate the development of better education programs and an economic base that will support this nation for the next few years. That is why school boards are in the business of curriculum.

The Need and the Rationale

Educators must be involved in the role of a public/private sharing of resources. At the present time in the state of Texas, more than 12 billion dollars are spent on education each year, which is more than one-half of the state's budget. At this time, Texas is four or five billion dollars short of what is needed to provide a minimal education.

There are other factors that demonstrate why school boards should be more involved in curriculum-related issues. In Texas, the student population is growing at a rate of 50,000 youngsters a year. The growth rate has been as high as 80,000. Ninety percent of that growth is due to live births and not to people moving in to Texas. The predominant growth area in Texas is in the Mexican/American population. At the same time, it is projected that by the year 2000, Mexico's population will double and there will be no place for them except across the border.

At the present time, 35 percent of the children in Mexico are dropping out of school. When the minority population is considered, the percentage of dropouts is as high as fifty percent. If something is not done about such problems, Texas will be saddled with a workforce that cannot produce a desirable future for its citizens. There will be a drain on the Social Security system and the welfare systems.

Education must be examined in a different light. Persons must look to the future in the United States and where the economic base is going. It is a sad day when an American company will not bid on a contract of major proportions to produce electronic driven educational programs, which may result in an economic base moving out of the United States. The United States should be taking advantage of many opportunities that are being given over to the rest of the world. The basic research is being done here but not the applied research that goes on to the manufacturing stage.

Many good things have been done in the United States in the education field; perhaps as good a job has been done as in any nation with such a diverse population. However, concerns are expressed when comparing education in the United States with other countries such as Japan. There is a cohesive body of individuals who are highly motivated in Japan. This is not because of better facilities or better teaching methods; it is because of the family support given to the children and because more time is spent on tasks. The United States must go forward, devising approaches appropriate to meet the needs of the educational systems and the culture, with the same kind of dedication that was used in getting to the moon. Billions of dollars must be spent to redo some things in the education field.

Competition for an economic, technical, and education base is no longer within the United States; the competition is worldwide. The United States must be able to compete better and/or cheaper; the only way to do this

is through technology. This means citizens must work cooperatively and share resources and talents. There should not be a competitive mode between the private and public sectors; it cannot be an "us vs. them" situation.

Schools cannot continue to be used to educate only K-12 students. A framework of *leadership* is now needed. We have to start dealing with people who can make the difference. As an example, a massive reform bill on education was passed in Texas in 1984. The reform was led by H. Ross Perot, who spent two million of his own dollars. He spent a year studying the education system in Texas, which resulted in the 216-page reform bill. He listed four major objectives: (1) recapture the class day for learning; (2) place an excellent teacher with excellent training materials in every classroom; (3) bring the parents back into the schools; and (4) maintain the best elementary schools in the world. Perot provided leadership in the state. He worked with the governor, lieutenant governor, and the speaker of the House. He went to every major business group in Texas and said, "Let's move forward." Like Perot, citizens must do something besides talking about changes. They need to consider how changes can be made and put together the implementation tools to put them in action.

The textbook-lecture methodology is not working for a large portion of the student population. Educators need to begin talking about how to do a better job and use technology for improvements. Students today are visual. They have watched television over the years, some as many as five and six hours a day. When a science program was first implemented in Texas, eighth, ninth, and tenth graders were intereviewed. They were asked, "What do you do with the textbooks, how do you study, and what do you do in your spare time?" In every segment of the population, whether in a high-level school or an inner-city school in Dallas, they reported they watched the Bill Cosby show. They did not read the textbook, and only used it to look up answers when they had to. What needs to be done is to bring to life the courses which are being taught and to make it exciting for students to come to school. At the present time, they are being forced into a mold that probably is not appropriate.

There are several other factors that led to the development of a physical science course in Texas. In 1982, educators and school board officials started examining the future of education in Texas. There are nearly 1100 school boards in the state, and 8000 boards are association members. These boards are composed predominantly of business people who represent a broad section of the state. When examining the long-range plan for education in the state, it was projected that by the year 2000, given the present growth and the needs that must be met, the cost of the education program would be $25 billion a year. The current state budget for two years is only $34 billion, which gives insight to the fact that education cannot be improved unless some changes are made.

Program Examples

Programs and approaches throughout the United States and in Texas were examined in order to accomplish the desired changes. There is a microwave system in the Houston area that is delivering education remotely to about 50 school districts. Although Houston is not remote and is a highly populated region, they are using technology to deliver inservice training for teachers and to deliver student programs such as calculus, Greek, and Latin. If there are not enough students in one school to justify offering a course and having a teacher present, technology is used to get the message across.

A satellite system in San Antonio, called "TI-IN" delivers various kinds of courses to several hundred school districts. There are two channels (two-way audio, one-way video) that go all over the United States, similar to what Oklahoma State is doing in some of its programs. That system is being watched and evaluated.

A complete Plato Wicat system has been installed in Garland, Texas. The 38,000 students in the district are on a terminal 30 minutes daily, drawing upon different courses. Apple has implemented a number of projects in

several school districts in Texas. CCC has a number of curriculum projects going on in the state.

After examining such programs for two or three years, it was decided to create a vehicle to facilitate the development of more comprehensive coursework in education. The Texas Learning Technology Group (TLTG) was established as a trust fund. Basically administered by the Texas School Board Association, TLTG began with a grant of $500,000 from the National Science Center Foundation, which is a spin-off of the Defense Department and the contractors of the Department of Defense. Twelve school districts were asked to match the investment at a three-to-one ratio and did so.

The Texas Project

The Texas School Board Association Videodisc Project started with two million dollars. The chosen project was physical science, which was identified by the Texas State Department of Education as the weakest course offered in science. Many students dropped out and did not take any science beyond the physical science level. The teachers in this area were receptive and had a very high level of interest in the project.

When the project was first begun by the Texas School Board Association, I went to the different political figures in the state--the lieutenant governor, the speaker, the governor, and the chairman of the State Board. They were asked for input and help in the long term of setting up the system. The board for the Videodisc Project is made up of one appointment from the lieutentant governor's office, one from the speaker's office, two appointed by the chairman of the State Board, five administrators appointed by the chairman of the School Administrators Association, and five board members appointed by the chairman of the School Boards Association.

The chairman must always be a school board member. The current chairman works and has built the worldwide data processing system for Mobil. He has implemented three engineering courses, using a consortium of companies to retrain petroleum engineers. Basically, the Plato system has been utilized, so he understands the problems involved.

When the Videodisc Project was set up, districts were asked to participate. Shares were sold in the project, and each share cost $75,000. A million and one-half dollars were needed, and school boards were asked to buy one or two shares; the maximum was two shares. Eventually, if the money comes back through the program, it can go back to the districts if they wish or it can be left for future development. State leaders replied affirmatively to the following questions: "If we raise the money now and implement this project, and if it is independently evaluated by an outside group and is successful, will you buy it for the whole state? Will you reimburse the people that invested so that money can be used for future development or go back to the districts so they will get their money back?" The next step to be accomplished in the project is the establishment of a state funding vehicle through which an equalized method is used to buy the hardware.

To begin the project, it was felt we had to start from the grass roots, so four working committees were set up from the districts that were involved. One committee was to deal with the physical science curriculum itself. This committee was composed of curriculum leaders and teachers from involved districts. A teacher training component committee was established, and an evaluation committee was formed to set up a careful evalution based on learner outcomes. A technical committee was chosen to give advice on the type of hardware and software configurations at which to look. These committees worked for approximately three months to determine what was wanted in the program.

AT&T was hired in the first phase to do the architectural design and in the second phase to do the prototype. In the third phase personnel from IBM were enlisted because they were going to be our partner for the hardware and technical networking that would be necessary in the system.

Personnel in the involved districts indicated they did not want one delivery system. If they could only afford one set-up, they wanted it

designed in such a way they could have a system that the teacher could use and that could drive the course. They wanted good visual materials and tools that would make them more effective, such as a lesson planning system, a grade book system, a word processing system, and a spread sheet system. They wanted some teacher disks that would explain how to set up the labs and show them the configurations and expected outcomes while upgrading them on how to use the equipment. They also wanted to have at least a year's lead time to learn how to use the equipment in order to be in a position of working with it in the classroom in a sensible way.

Texas educators wanted a system that was capable of networking; however, they also wanted it to be able to stand alone. They recommended utilizing a MS DOS system with at least 20 megabytes. Personnel from four universities were enlisted to help with the teacher training. Personnel from these four institutions of higher education have been working with the preservice training that is involved and also with the upgrading of teachers in the field to bring them to the level where they can deliver a better physical science course.

One of the configurations to be delivered is a teacher only configuration, using a big screen approach where the teacher will drive most of the course activity. It will still be level three, but teachers will be the driving force. The next configuration district personnel wanted was a teacher and group setting so that the teacher station could also act as a group station. They wanted to put together groups of five to seven students who would do simulation models and thinking skills models using peer interaction. It is a very difficult delivery system. Teachers are not used to working with this type of an arrangement; more sophistication is necessary to plan hard disk video presentations because there are many more things to think about. About six units are needed in that type of configuration for a class of 30. The teacher unit will cost approximately $8,000 to $10,000; it will be a very sophisticated unit. The individual station units will cost $5,000 or less.

By the fall of 1987, TLTG will start piloting these two configurations with chemistry and physics. It is planned to do 160 hours and is being integrated into the curriculum in such a way that the textbook is used as a supplement. After working with it for awhile, the teachers said, "We can deliver the concept so much better this way. Why don't we do the core concepts the students really need and let us add to that rather than teachers having to do the delivery. Let teachers change their roles so they can work with the students on a one-on-one basis rather than lecturing five periods a day, every day."

The teachers next said they would like to be able to have a teacher station, group stations, and individual stations in order to teach the core concepts all three ways and reinforce them in different ways. Teachers felt multiple approaches could make science exciting for the learners.

The state requires a 40 percent wet lab in the physical science course; the State Department gave permission to simulate 20 percent of those labs. An analysis of these simulations will be made to determine if they are as effective as the traditional lab.

The project will also be evaluated in another way. Research will be conducted to see how it works with different types of students. In the involved districts in the project, classes can contain all black or brown students and various mixtures of socioeconomic class. Each of the 12 schools will run a pilot and will probably have two teachers with different configurations. Baseline data are being collected, and at the present time teachers are taking an attitude, an aptitude, and an achievement test that will be correlated. An input, output model, developed at the University of Texas, will help in the examination of each of the project parameters.

The teacher station will be networked with a full set-up, including a scanner to grade tests and keep records. Hopefully, a laser printer will be tied into the station. Eventually, it is hoped to network up to the full campus, district, and perhaps even state level.

Testing is very important. When the course outlines and five textbooks used by the 12 schools were examined, it was discovered the weakest link in the process was the test. It was decided to build in a testing bank to measure each of the objectives. In order to achieve this, project members are working with two groups--The Psychological Testing Service, a branch of Harcourt Brace of San Antonio, and the Educational Testing Service (ETS) of New Jersey. The goal is to eventually individualize in order to enable prescriptive learning, to identify what learning problems students have, and to be able to deal with those in a different way.

A process evaluation will also be done on the project. Certainly the spin-off of having special attention will have some effect on the students. Researchers have indicated that students learn quicker and have better rentention, which is the reason success has been predicted. However, it will not be successful unless the teachers let it be successful and build in and on this first project. The best and brightest teachers in the selected schools will be chosen to make sure it is successful. Certainly, the teachers are the most important component of the project. At the present time, teacher career evaluations are based on performance; however, during the project the teachers will not be performing as much. They will be working with individual students and helping them. Their role will change from performer to manager of the process.

The major decision to move from AT&T to IBM was based on two factors. One was that the price bid by AT&T was too high, and the other was that fact that IBM was ready to come out with the InfoWindow project. Project members went to Jim Dezell of IBM; he replied IBM was still interested and agreed to supply equipment to the participating schools. After the decision was made, IBM was given a challenge. This summer, a full week of training was held to help teachers with the technology concepts; most of them did not have any such background. Teachers were paid $300 to come in for inservice training; there were approximately 40 teachers and administrators. Teachers will come back for more inservice and will work with a module that will come out in December or January. There is an effort to involve the teachers and identify the problems. Reg Pettus was given a challenge; he was given the videodisc and had a week to convert it to the InfoWindow. Comments by Reg Pettus concerning the project and the challenge given him follow:

> Jim met with Orbry Holden down in Texas, and Jim Dezell has a real passion for education and IBM's commitment to education. I am sure many of you have heard about the write-and-the-read program which we have put out, and also the recent entry of adult literacy we hope we'll spread to the classroom. Jim came back and said, "I want you to go to Texas and look at this application and tell me whether or not it can be converted." I went down and met with Orbry and Steve Brown. In the middle of the conversation Steve asked, "Can this be converted?" I said, "I have the disk; I saw pretty much what it looked like under the AT&T configuration. I would like to make some changes. Can I have a copy of the videotape of us going through it and a little bit of the design document?" He said, "Sure." As I was getting ready to go back to the plane, Steve asked, Can you have it ready in a week?" Now I know what a tailor feels like when you buy a suit. We took it back and worked on it for awhile and had some co-ops take a look at the graphics that were requested. The students working for IBM on a part-time basis looked at it; they said, "It's no problem; we can get that done. With a few phone calls between Atlanta and Austin, we were able to do the basic course outline for this particular application and to do a lot of the programming or authoring to make that happen. I won't lie to you; we did not finish it in a week. We brought everything to the teacher's session at Hurst-Euless-Bedford School, outside of Dallas. We spent a couple of nights right before the conference finishing up the authoring.

As an aside, I looked at one of Orbry's slides; it was a graphical representation of a child lying down and watching

television. I will be the first one to admit that I took the hardware and software home to finish up some things before I made the trip to Texas and on Saturday morning I witnessed something very surprising. I was testing out a lot of footage that was shot on the authored format. My nine-year-old totally forgot about his morning cartoons and started playing with the hardware and was actually going through the electromagnetic spectrum. This tells me I have basically made a personal commitment to this technology because education in the United States needs a great deal of commitment, not necessarily just from the schools' position but from the private sector. There are many concerns today about the quality of the employees in private businesses; something needs to be done. Hopefully, with companies such as Sony and IBM, the teaching community will be provided with the necessary tools in the classrooms to help students want to come to the classroom and learn the skills necessary to become quality employees.

The teachers will be given a tool kit which the students can use and have a word processor/calculator type application. With the network version, the teacher and students will be able to send electronic messages, homework assignments, and other things back and forth. I would say this particular prototype on the electromagnetic spectrum, approximately five hours, probably rates a five on a ten-point scale. We have learned by doing it. As we go on, we will become better and better as we do the designing and implementation. This particular disk could be taken by any company and reauthored. We will work with one vendor until it is perfected; at that time we will contract for national distribution. Currently, IBM is the group with which we will work, and they are the ones who are giving us the support, the hardware, and the talents of many people. Two millions dollars is being spent by IBM on this application for their own training programs; they claim it will save them $200 million, which can be put back into their education unit.

Pettus commented:

It's true; we found that it allowed us to educate our students much faster. We have had courses that have taken three to four days and to us, three or four days out of the field was costing us a lot of money. The programs can now be finished in two days; in addition, the rate of retention is much higher. All three TLTG applications on the electromagnetic spectrum were done twice. One was done in the standard classroom format and resulted in the demonstration format; the student can now actually sign onto the system. Using the screen as a keypad, based on the design, the students can examine the pretest scores and find out what they need to review. Interaction is all through the touch screen.

There is a need now to begin planning for the development of the curriculum on a national basis. Approximately one billion dollars would be needed. Work should be coordinated at the federal, state, and local levels to make sure the money is not wasted. It is coming to the time when such plans are feasible, possible, and can be cost effective. If students and teachers become more productive, these expensive systems can be justified.

The timing is right to do this if it is done well; we can move ahead with a commitment to make it work. We are committed not only on the short term, but on the long term. We want to build a $50 million trust fund that continually goes into the facilitation of software. We went people to put money into resources that will make a difference in helping students learn.

PLANNING VIDEODISCS IN THE LITTLE RED SCHOOLHOUSE

Ward Sybouts

Introduction

As persons have moved from an agrarian society through an industrial age and entered the information age, we have witnessed revolution, the earth has moved under our feet, and yet we have become so accustomed to changes taking place about us we no longer seem captivated by the changes nor by their implications. Within education, which in this respect may be used as illustrative of society as a whole, it can be said that changes often happen to the institution of education with little or no immediate direction from educators regarding those changes.

At approximately the turn of the current century, my father attended school for three to four months each year. His formal education started when he was age five and ended when he was 16. He was a good student. As he explained it, he had read every book in the school and could answer any question from any book and work any problem in any mathematics text.

Of course it should be pointed out there was the proverbial "reader," one general mathematics book, an algebra text, and a geometry book. One book was available on the topic of European history, one on American history and government, an English grammar text, and a book of poems and English literature. This listing of books constituted the entire world of formal knowledge for a small immigrant boy at the turn of the century, with, of course, the Bible added from a shelf at home. And, yes, he did walk three miles each way to school in the dead of winter.

But moving on to more recent years and looking at the world through the eyes of a person who can recall the era of The Great Depression and the following decades, dramatic contrasts can be traced through the post-World War II years, through the tumultous late '60's and early '70's, and into the decade of the '80's.

This was a time when universal education was becoming a reality, when "equal but separate" education was found unconstitutional and the "least restrictive environment" was to be available for each student. It was a time when there were so many teachers prepared they became a glut on the market, and there were also teacher shortages that occurred alternately during the same thirty-year timeframe. It was a time when leaders in the field of education argued and lobbied to prevent the intrusion of federal aid to education on the grounds that it would be much too costly and wasteful to channel funds from local taxpayers through the federal bureaucracy and back to local districts; secondly it would mean a loss of local control and initiative. It was an era when educators appeared in the nation's capital to argue for continuation of support from the federal government for education. The lobbyists for federal support to education claimed there was no way designted programs could exist without federal support.

The center cut of the current century was when television burst upon the American scene along with penicillin, polio shots, jet propulsion and space travel, plastics which have been used for innumerable things, not the least of which is the credit card, and so many technical advances that it requires a massive library to simply index the listing. Within the same timeframe, society members have been re-examining what had once been considered "basic truths" which relate to how people address ethics and morality. The earth continues to move under the feet of its people.

The videodisc is one form of technology that has become available to educators to be

utilized in schools within the changing world. When the term "utilized" is employed, it may, however, carry various connotations to the educator or the specialist in technology. "Utilized" may mean interjected into a program; it may mean integrated or it may be perceived as something to be added to a program; it may be viewed as a source of information or as a methodological approach; or it could be seen as one more tool which can supplement those already available or, as a complex form of technology, held up as a panacea for revolutioning the educational establishment.

The manner in which videodisc technology is to be used and the results that will be derived are not yet fully known. For the most part, there are scenarios, isolated examples of use, and limited research along with speculation regarding the impact of videodisc technology as an educational device and process.

As educators view videodisc technology, they are looking at something that was not invented by educators, but they are viewing a form of technology that has to be adapted for use in the field of education. Consequently, a natural chain of events emerges that involves the developer of new technologies, the programmer and designer of software, and educators who will have the responsibility of adoption. Implicit in this chain is the need for a dialogue among all the parties involved.

As education and society have moved from a one-room school, with an information base consisting of one teacher supported by a mere handful of books, and as the society in which education functions has become more complex, a much more difficult and demanding set of conditions has emerged. Technology has much to offer *if* educational, political, and commercial interests can discover how to make the best possible application of a complex technology to assist learners.

Leaders in education need to take steps to activate all significant players within the chain of contributors in order to capitalize upon a consortium of expertise that will move videodisc technology into education. The leaders within this consortium will need to draw upon the available database recognizing the major trends in society that span sociological as well as technological and psychological implications.

As a part of the backdrop against which videodisc technology must be placed to move forward in education is a call for a redefinition and clarification of the purpose of education so that leaders in local educational agencies, developers of hardware, and programmers of software can state with precision and clarity goals for learners within each local school. Planning emerges as a central consideration for moving forward with the adoption of videodisc technology in education. However, more sophistication in planning is called for and a greater adherence to the discipline of planning will be required than has been evidenced in moving other forms of technology into the classroom.

Results obtained through the use of videodiscs in the classroom will have to be tested and retested, and follow-up efforts developed to provide the best possible database for continued development. To accomplish the adoption of videodisc technology into the educational enterprise, educators will be required to demonstrate an understanding of how change takes place and a willingness to accept changes that may impact upon the norms and traditions of education in a way unheard of up to the present. Educators have a choice; they may simply accept what comes or they may posture themselves in a proactive stance and assume a leadership role and plan for the implementation of technology into the school setting.

An Historical Perspective of Technology in Education

The recent history of technology in eduction has been centered largely in the area of microcomputers. Within the brief history of microcomputers in education can be found some interesting and valuable lessons. Most observers are very much aware of the fact that only a few years ago there were no computers in classrooms. With the advent of the mainframe computer and expanded uses of large computers, various instructional pro-

grams were developed. However, the cost of computers for instructional purposes formed an insurmountable barrier; while computers became tools for research and management, they were not practical for instruction as viewed from a cost-benefit perspective.

With the introduction of the micro chip and the microcomputer this changed, and within the span of only a few short years the number of microprocessors found in classrooms went from none to hundreds of thousands. However, with the phenomenal growth in numbers of microcomputers, there was not a parallel growth of sophistication reflected in the use of microcomputers for instruction. As recently as 1982, there were indictions that approximately 90 percent of the teachers who took introductory courses in computers were not, for a variety of reasons, employing them in their classes one year later. More recently, data have been presented that are much more encouraging; it was reported that approximately 14 percent of the elementary teachers and up to one-third of the senior high schoool teachers were using microcomputers for instructional programs (National Association of Secondary School Principals, 1986).

These data still do not reveal how appropriately and extensively the teachers employed microcomputers. It has been suggested that available information could reveal rather limited use of computer technology is still the dominant pattern in K-12 schools. Even the pupil-computer ratio of 3.8, as reported in selected lighthouse schools, can be a meaningless figure unless it is known how the technology is used and what results are being achieved. Recent observations by Snyder and Palmer (1986) suggest that up to 90 percent of microcomputer software is not worth the diskettes on which they are recorded.

When microcomputers are used to bring technology into the classroom, some excellent programs in progress can be seen; however, a great gap between what has been accomplished and the potential that exists remains. When viewing the state of the art and the steps taken to adapt microcomputers to education, various observations can be made to provide important lessons to persons who take the responsibility for moving videodisc technolgy into the instructional setting.

Complex technological innovations do not yield to simple steps for adoption in education. As the complexity of the technological innovation increases, there is a seemingly parallel increase in the complexity of the adoption process. While the overall adoption process may be defined in an identical way for adopting a simple innovation as it would be for a complex innovation, to activate the adoption or change process for a complex innovation is much more demanding than might be expected. The added complexities that accompany technology stem only in part from the technology itself and are imbedded more acutely within the human factors that are at play in the process.

Tradition and the institutionalization of the educational enterprise play major roles when considering the adoption of a complex innovation in education. While the lack of funds is often decried as a major deterrent to innovation in education, funding is often nothing more than the screen held up as a subterfuge for avoiding change. However, the lack of purpose and clarity of goals have caused confusion and, in some instances, led to the actual misuse of technology for instruction.

In like manner, the adoption of technology for instruction has been hindered by still other mind sets on the part of some educators who first see little or no benefit to be derived from the database that is available and secondly do not perceive any need for making major changes in education or even doing any fine tuning to the current system. Consequently, basking in the affluence of their complacency, there is no interest on the part of some educators to become familiar with the knowledge that is in the literature and reflected in the best practice that has been demonstrated regarding managing the change process.

Hindsight, even with its distortion of perceived clarity, can be used to glean some valuable indictors with respect to how change takes place within the educational enterprise. Reviewing the process of adopting the overhead projector in contrast to the

microcomputer can bring to light some interesting contrasts.

The Overhead Projector	The Microcomputer
A simple device	A complex instrument
Software generally made by the classroom teacher	Software generally designed and programmed by professionals
Inexpensive	Costly
Enhances existing methods and organzation as well as curriculum	Challenges old approaches and presents new options
One-half day of inservice required	Extended and ongoing in-service required
Has easily perceived capabilities, and the potential is visible	Has greatly expanded capabilities, and challenges those with vision to consider the potential
Does not intrude upon old habits and values	Challenges previous beliefs and values
Supportive of teaching in isolation and is non-threatening	Opens options that can be a threat to the perceived role of the teacher, and requires new forms of planning, organizing, diagnosing and prescribing in the classroom
The teacher continues to be the purveyor of "truth and knowledge"	Teachers have to learn how to be a manager of a system that may replace teachers as the primary knowledge source
Easily integrated into the classroom	Requires new skills, perceptions, and techniques to adopt into classroom
Correct, or at least adequate, use easily achieved	Complex and easily misued

It is possible to find excellent examples of teachers who have developed a high level of expertise in the use of microcomputers for instruction. The range of uses has been demonstrated to include computer-managed instruction, problem solving, the development of higher order processes and understandings, and the assistance to instruction for lower-level activities. The quality and sophistication of software have improved noticeably in recent years and months. While excellence can be found in the use of technology in the classroom, it is also possible to point to widespread misuse or lack of use as reflected in the following quotations:

> We want to use the computer to raise our average students so they will all achieve in the top ten percent. (superintendent)

> We are not going to put micros in our schools. Students need to be able to perform basic math functions by hand to understand what they are doing. (board member)

> What a computer can do is no more than what I can do with a duplicated worksheet--and the worksheet is a lot less expensive. (teacher)

> Our goal is to build a computer lab and have it ready to go by next fall. (principal)

> Our computer curriculum is just fantastic! We love it! No, we haven't done any evaluation. (principal)

> I keep the computers locked when there is no computer science class in there because we don't want kids just playing on the machines. (teacher)

> How am I going to tell my board and community that we have $60,000.00 invested in computers and can't find any software for our students to use? (superintendent)

> Our objective is to get a computer in every elementary classroom. (elementary principal)

> When we bought the machines nobody said anyting about needing all this software and training teachers. (superintendent)

There is evidence that in many schools computers are put to minimal use in terms of the amount of time students are working at terminals. Sales representatives tell jokes about selling a second order of computers to a

school administrator to replace the first computers, which were never used. Corresponding observations suggest that even more distressing than idle computers is the situation of misuse of computers found in some settings. Large numbers of districts can be found in which there have been no staff development programs to assist teachers in the use of computers for instruction.

Patterns which have detracted from the potential of microcomputers in the classroom can be found in practices which have placed an emphasis on the acquistion of hardware with little or no consideration to staff training and obtaining quality software. Evaluation of results has been less than adequate. To find a school in which staff members have established well thought-out goals is an exception. It is not uncommon to encounter teachers who have been unable to adjust to the use of the microcomputer as an instructional device; consequently there is no evidence their approach to instruction has changed from their previous style of teaching. It is also unusual to find a school in which there is evidence of a planned approach to the implementation of computers and in which there is an awareness of how change can be managed. It should be made clear that not all school situations are reflected in the patterns of misuse listed above. Excellent programs can be found in which there is ample evidence to point to well-planned and conducted programs in which microcomputers are used. The unfortunate thing, especially for students, is that there are too many instances in which the micro is either underutilized, misused, or both. Perhaps educators can pause and reflect on how microcomputers, as a form of technology, have been introduced into education and, while recognizing obvious differences between microcomputers and videodiscs, learn from recent history regarding the adoption of microcomputer technology into the classroom.

Planning for Technology Needed

Developers of technology and those who use technology in the classrooms need to recognize the importance of working together and becoming highly skilled in the planning process. An approach to planning is needed that can be implemented to help leaders in education move technology, of various types, into instructional settings in a way that will enhance the educational process and benefit students. A planning process of sufficient complexity and comprehensiveness to adequately move technology into the classroom will require a high degree of discipline and an extensive understanding of people. Numerous planners have suggested approaches to planning that contain various steps which are sequenced in a number of different ways. Planning, like many endeavors, can be accomplished in a multitude of ways. There are, however, some concepts that should be embodied in any planning approach. When examining planning schemes that have proven to be successful, several components have been found that are common. By looking at the reverse side of the coin, it is possible to find planning or implementation efforts that have been less than successful and to see what was *not* done in the planning process. Examination of research on the change process will verify the key components of the process and aid in successful implementation of efforts.

In general, successful planners will understand and employ the following steps when introducing technology into an educational program: (1) a review of the context in which the innovation is expected to take place; (2) a clarification or determination of the mission to be accomplished; (3) specification of measurable outcomes; (4) establishment of criteria for knowing when outcomes have been achieved; (5) the accumulation and selection of options to be considered in designing a program to implement technology in the school (once the available options have been identified it is possible to determine the sequence of options); (6) the design of the program for the staff to pilot or, if conditions permit, implement; (7) evaluation; and (8) revision, continuation, or termination of the effort.

Review the Context

An examination of the context or setting in which an innovation or an implementation effort is to take place is an important and sometimes overlooked starting point.

Sometimes referred to as environmental scanning or as a review of basic considerations, the review of the context should be conducted in such a way that all significant persons are involved. The review of the context should take into consideration a wide range of topics that relate to implementing technology into the educational system. For example, what changes are taking place in society that suggest technology is appropriate in the classroom? What socioeconomic considerations should be taken into account with respect to equity issues? What does technology hold for the future and how will the graduates of today's schools face that future? What do the laws of state and teacher certification requirements suggest with respect to using technology in the classroom? What are community or parent expectations? What financial resources are available? What about the developmental stages of the students to be served? The list can be expanded. Basically, planners need to identify and clarify any area or question that could have a bearing on what is to be accomplished. The reason for enlisting all significant individuals in the review of the context is suggested to be sure all persons involved will have such information for a common base of agreement. This base of agreement should also be used as the planning process unfolds to serve as a platform upon which internal consistency is ensured.

Internal consistency is required for a good plan. Simply stated, internal consistency is found when all segments of a plan are consistent with all other segments. An illustration of a lack of internal consistency can be found in what was done some years ago when school officials who moved into modular scheduling in secondary schools listed one set of objectives, such as better reading skills, more independent thinking, and greater assumption of the responsibility for one's own actions on the part of the students, and then at the end of the year gave a standardized achievement test and performed no other form of assessment.

Clarify Mission

Mission clarification may be considered automatic and unnecessary. However, successful planners have demonstrated that all persons involved should have a clear understanding of what is to be accomplished. If a lack of mission agreement is found, confusion and wasted effort will occur. When considering the adoption of a form of technology into an educational program, it is advisable to focus the direction of the mission statement on what is desired educationally in terms of outcomes or educational results. All too often, there have been instances in which an emphasis was placed on a process or non-educational product. This can be illlustrated by considering a scene that has been repeated in numerous educational institutions where, at the point of initiation, a decision was made to establish a microcomputer laboratory with no specification of what educational outcomes were to be achieved. The establishment of a computer laboratory is only an appropriate way to organize and arrange hardware *if* there has been a determination of what educational outcomes are to be achieved and *if* a computer laboratory will facilitate those specified educational oucomes.

Mission clarification enables all persons who are involved in the planning and implementation process to move directly toward the accomplishment of that mission. When all concerned persons know what it is that is to be accomplished, there can be greater harmony and efficiency in working toward the accomplishment of desired results.

Specifying Measurable Outcomes

Much has been written about the preparation of measurable outcomes. When considering the process of implementing technology into an educational system, such as the videodisc, there are two general areas in which planners can derive major benefits from carefully defining the desired outcomes. First, careful attention to the way outcomes are specified will enable all persons concerned to have a clear agreement about what is to be accomplished and to be able to examine the outcomes to ensure they are consistent with the mission and the basic assumptions upon which the total program is to be built. Statements of desired outcomes or objectives are an extension of the mission statement and will provide the specificity needed to enable staff

members to know exactly what is to be accomplished. Second, carefully specified outcomes will provide the information needed to establish the criteria for determining when objectives have been reached.

Establishing Criteria for Evaluation

It has been suggested that evaluation of a program effort is, in the vernacular of Mark Twain, like the weather; there is a lot of talk about it, but few people do anything about it. When good intentions abound and eager souls embark upon a complex effort such as implementing technology into an educational system, there is a natural enthusiasm to "get on with it." The unfortunate thing about such exuberant starts on major implementation efforts is that they lead to an unfruitful condition at the end of the efforts in which little or no data have been gathered to provide answers about whether the outcomes were achieved. The time to establish the criteria by which goals or objectives are to be assessed is early in the sequence of the overall planning process. If criteria are established early in the process, there is a greater assurance there will be an appropriate emphasis placed upon evaluation, and it will be possible to design an evaluation scheme that will help make a measured determination with respect to whether the goals were or were not achieved. An early determination of criteria for measuring outcomes will lead the planners to a better understanding of how to conduct an ample assessment; at the same time it will give further attention to ensuring that internal consistency is fostered.

Select Options

Options for implementing technology into an educational system can be chosen most judiciously after it is known what is desired in terms of measurable outcomes or goals. Efficiency of effort can be achieved if options are selected or designed that will contribute to the achievement of the specific, clearly specified outcomes. Random selection of options can be extremely unproductive. By contrast, when it is known what is to be achieved and options are selected that will make a contribution to the achievement of desired outcomes, it is possible for a staff to move more judiciously and purposefully toward achieving specified results.

Sequencing options is an area that warrants careful consideration. The sequence or general manner in which a plan is put together should be based upon some of the initial considerations on which attention was focused and agreement sought in the first step of the total planning process. Again, a page from the recent history of education with respect to the introduction of microcomputers into a school system can be considered. In countless situations, the first option considered was the acquistion of hardware. In school district after school district, there were orders taken by salespersons for microcomputers in schools where no attention had been given to software or to the topic of self-development, and no determinations had been made regarding educational outcomes. It was common to hear a school official state an order of computers had been received and there was no staff member in the district who had any knowledge or training in the use of such equipment. Clearly, in these situations, the cart had gotten in front of the horse. In such situations there was inefficiency and, in general, a set of conditions that could not be viewed as productive. Fortunately, such mismanagement is neither inevitable or unavoidable. Within the planning process, at the appropriate time, it is possible to select and sequence options that can provide an assurance goals will be achieved.

Pilot or Implement

Generally, any complex process of adopting a form of technology into an educational system calls for a trial effort. A trial effort or a pilot is a judicious step in order to do local field testing and evaluation. There are situations when it is appropriate to move directly into an implementation phase of a project, but as a general rule most implementation experts advocate a pilot program. A trial effort or a pilot can take on various forms. It is possible to simulate a project and, in so doing, determine some of the possible problem areas and outcomes. Pretesting, trial efforts, or pilot programs will generally provide a productive phase of any implementation efforts.

Through a pilot effort, it is possible to gather data about the process as well as the outcomes. A pilot effort will provide a reasonable, generally low-risk setting in which planners will be able to determine the potential effectiveness of an effort to implement videodisc technology into a school. During a pilot program there can be a minimal investment of staff members, software, and hardware.

Evaluation

Planning for evaluation should begin during that phase of the total planning effort in which criteria were established for assessing results. The evaluation process should be conducted continuously once criteria have been established, right on through to the completion of the pilot phase of an implementation program. Actually, the sequence seems overly simple: determining goals to be achieved, establishing criteria for evaluation; measuring process and product indicators during the pilot phase; and analyzing the data.

During the pilot phase of an implementation project, an emphasis on both process and product is warranted. By assessing what is happening and how it is happening is of value in order to make corrections in the process. The product becomes an obvious focus of attention. It is not enough to suggest that people like a new method or by contrast do not enjoy it. There must be a clear, goal-related outcome that can be demonstrated as achievable with a new technology.

Revise, Renew, Go, or Stop

Once the data have been gathered and analyzed, it is possible for planners to examine what has taken place and what has resulted and to then make a determination about the future of an implementation project. Decisions to terminate, to proceed, or to review and try again should be data-based decisions. Such decisions become dependent upon the evaluation efforts.

Understanding How to Manage Change

In recent decades the field of literature relating to the management of the change process has rapidly expanded. Some of the first scholars who made extensive efforts to explain how change takes place were in the discipline of anthropology. It was through the research of persons such as Barnett (1953) that the conditions which were antecedents to change were listed. Later researchers in the field of sociology analyzed the behavior of groups of people involved in or experiencing change. It was through the work of sociologists that the time it took for an innovation to be adopted, or the S Curve concept, was developed and later applied to the field of education. Drawing from the previous studies in sociology and anthropology as a base, change was studied in agriculture and medicine and, still later, in education (Haney, 1980).

It has been suggested that change, or the adoption of an innovation, takes place in education through the completion of several steps: awareness, the development of an interest in the innovation, an evaluation of the innovation, and a period of trial and finally adoption (Carlson, 1965; Lionberger, 1970; Rogers, 1965). An expanded understanding of the adoption approach to change came from the more recent work done by Hall (1974) who identified phases of adoption and later suggested the importance of understanding stages of concern (SoC) and levels of use (LoU) as teachers become involved with the adoption process.

While the above-mentioned models are appropriate for the adoption of some device or innovation, there are some advantages to be found in a different kind of process model when considering the planning and development of a curricular change or some innovation that must be designed and implemented into a system. The Systematic Change Process was prompted by the need for a process change model that capitalized upon systems and at the same time drew upon the literature on change (Haney, 1980). A process model is less appropriate for "adoption" and more applicable when the innovation called for is actually designing changes in a process or a

program. While it can be argued that a technological device, such as a videodisc, is invented and therefore needs only to be adopted, the complexity of the process of implementing it into the educational system becomes so involved that the more elaborate process model is more functional and can be of greater utility in planning for complex changes. It is further suggested that the steps outlined on previous pages which are based on a systematic change process afford the change agent a better sequence for the purposes of management and ultimately evaluation. Another dimension of the systemtic change process is the ability to bring together that which is known about change and that which is reflected in the planning literature.

Finally, the systematic change process is one which will accommodate human considerations in both planning and managing change. People have to feel secure during periods of change; they need to realize and believe that taking a risk does not put them, as individuals, in jeopardy. The values of those involved in change must be respected. The reward system must be managed in such a way to ensure reinforcements and support to participants in the change process. As is so well known, each person investing in the change process must be granted the opportunity to develop ownership. Change agents who understand the human dimensions and can employ such knowledge in the management of the change process will be more likely to demonstrate positive results.

Conclusion

As suggested previously, those who would introduce videodisc technology into the educational process and do so in such a way to provide some assurance of success will in most likelihood be individuals who know how to use data. There have been numerous studies and experimental efforts in recent decades that have enabled researchers to make valuable contributions to the knowledge base regarding planning and the management of change. It is neither justifiable nor even possible to reinvent all such information by calling upon an n of one, which is often done when a person responsible for managing change forges ahead using no more than personal experience as the data base. The re-creation of the wheel cannot be justified, particularly at the dawning of the information age.

Technology is expanding and society is becoming more complex. Education cannot serve a new society with an obsolete enterprise. While the achievements of American education are unparalleled, the fact there is so much change within the culture places upon leaders in education the imperative of keeping the educational enterprise abreast of the culture it was designed to serve. Change within education is unavoidable. The question then is whether educators will accept changes imposed upon them or if leaders in the field will place a hand on the tiller and assume a greater share of the challenge of determining direction for the total educational system.

Many positive changes have taken place in education in the use of technology. However, in light of the potential and when considering the total educational structure rather than selected schools of excellence, an inescapable conclusion that must be recognized is the use of technology is not as widespread as it could be, nor is the use of technology in the schools at a needed level of sophistication. Reasons for not capitalizing to the fullest on microcomputers in schools are numerous and will vary with the site. However, generic weaknesses in planning and a failure to grasp the intricacies involved in managing change are perhaps the two major factors that can be identified in the shortfall being experienced with the use of computers, or technology as a whole, in schools. There is a valuable lesson to be drawn from the recent experience with computers in education, as leaders in industry and educators work to implement videodisc technology into the schools across the nation.

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SECTION III

THE STATE OF THE ART

THE DEVELOPMENT AND VALIDATION OF AN INSTRUCTIONAL VIDEODISC PROGRAM

Alan M. Hofmeister, Siegfried Engelmann,
and Douglas Carnine

Introduction

The development and validation activities conducted to date on "Mastering Fractions," an instructional videodisc program, are reported in this article. The information is organized around the following three phases.

Phase l: Formative Development. In this phase, prototype versions of the product were field tested and revised until predetermined standards of student mastery were consistently achieved by members of the target population. The standard used called for 90 percent of the students to demonstrate mastery on all the instructional objectives. Observations from the formative development and validation activities are reported in Part l of this paper.

Phase 2: Stress Testing. Realizing that many teachers are required to teach under conditions less than ideal, an instructional product should be "overbuilt." It should be robust enough to work in difficult settings. The product should help the teacher solve problems, not add to the teacher's problems. In stress testing, the product is purposefully exposed to challenging instructional settings. In such testing the product's effectiveness may be evaluated by comparison with some predetermined standard, or it may be compared with another instructional product designed to teach the same instructional objectives. Results from the stress testing are reported in Part 2 of this document.

Phase 3: Independent Regional Implementations and Evaluation. In this phase, school districts in different geographical areas review the product and implement it and evaluate its effectivness. In these regional implementations the manufacturer may provide a discount of approximately 20 percent to encourage such evaluation. If issues of cost effectiveness are to be validly treated, the school's initial review should indicate that the product is worth expending school resources to purchase the versions under evaluation. This phase should provide data to verify earlier decisions on the appropriateness of the curriculum and the quality of instructional procedures. Phase 3 is an ongoing activity, and a progress report is provided in Part 3 of this paper.

Additional information on videodisc technology. An article by the authors, describing interactive videodisc technology, follows and provides information for readers unfamiliar with the more recent developments in this field.

Part l: Formative Development Observations from the Development and Field Testing of an Instructional Videodisc Program[1]

The observations made during the formative development of a series of interactive videodiscs for high school math and science are reported here. The series, entitled "Core Concepts in Math and Science" (1985), was developed by Systems Impact, Inc., a private corporation supported by faculty members at several universities and the administrators and teaching staff from several school districts coast to coast.

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[1]This report has been adapted from the paper: "Designing Videodisc-based Courseware for the High School, by A.M. Hofmeister (Utah State University), and S. Engelmann and D. Carnine (University of Oregon), which was presented at the American Educational Research Association Meeting, Chicago, 1985.

In the development, a heavy emphasis was placed on designing the products to meet the needs of students with different skill levels. During field testing, particular consideration was given to the inclusion of students in need of remediation as well as to students progressing without difficulty.

Instructional Format

In designing a dual-level interactive videodisc product, a decision had to be made regarding whether to emphasize Level 1 or Level 3 initially. The reader unfamiliar with the terms "Level 1" and "Level 3" should refer to the article "Videodisc Technology: Providing the Teacher with Alternatives." It was decided to emphasize Level 1 procedures in the initial stages of development, because the Level 1 format, with its group presentation and its reduced facility for extensive branching, required very effective instructional sequences.

If the instructional hierarchies are not valid and the important prerequisite skills are not identified and mastered, the Level 1 format will not be successful. In a Level 1 format, with its reduced capacity for individual remediation, failure experiences associated with the presentation of new material must be reduced. Rosenshine and Stevens (1986) have noted:

> New learning is easier when prior learning is readily accessible or automatic. In a large number of academic situations the student needs to apply and use the knowledge or skills that have been previously learned. (p. 378)

This constant attention to the mastery of prerequisite skills is one of the ways success is assured in group-based instruction.

The Level 3 format, although far more expensive to implement, is more tolerant of inadequate instructional sequences because of the increased facility for remedial branching and because of the potential to supplement inadequate videodisc content with microcomputer-delivered material. When the initial emphasis is placed on the Level 1 format, the quality of the Level 3 format is also enhanced through the use of better sequences and fewer failure experiences, with their associated remedial loops.

Because of the heavier involvement of the teacher in the Level 1 format (see the article, "Videodisc Technology: Providing the Teacher with Alternatives") it is essential that field testing is carefully monitored to ensure success can be attributed to the product and not to unrecorded adaptions of individual field-test teachers. Such careful monitoring also allows the observations and recommendations of the field-test teachers and observers to be added to those of the product developers and the content and design consultants.

Development and Validation Procedures

The major development and validation procedures included:

1. *An analysis of school district curricular and textbook content.* For each course, curricula from school districts in several geographically separated states and four or five widely used textbooks were used for the initial curriculum analysis.

2. *An initial listing of possible core concepts.* In selecting core concepts the intention was not to try and teach everything, but to select the most common and most important foundation concepts, and teach them well

3. *A review of the initial listing by content consultants and the associated revision of the listing.* Consultant input at this stage was primarily concerned with the selection of the most important concepts and their approximate instructional sequence.

4. *The preparation of "track scripts" and their review by consultants.* A track script is a preliminary draft of the videodisc script for a specific curriculum strand. Through the review process, consultants make input on sequence, terminology, and instructional presentation issues. A course will contain several curriculum strands and their associated track scripts. The use of track scripts makes the underlying curriculum structures visible to all and facilitates revision on a modular basis.

5. *The development of prototype field-test lessons.* Lesson scripts are prepared from the revised track scripts. Videotapes and

additional print materials are used to approximate the videodisc presentations in the field testing.

6. *The field testing and revision of prototype lessons.* The process of field testing and revision is repeated until product effectiveness is consistently demonstrated. To date, courses have been through three to five revision cycles. In a typical field test, there will be two groups, approximately ten lessons apart, being field tested at the same time. As problems are encountered in the first group, alternative procedures are developed and tried on the group that is ten lessons behind. Such a procedure allows for extensive product improvement in a limited time period. The field test and revision cycle is repeated until a version is developed that is consistently effective. Field-test and revision cycles were repeated until 90 percent of the group had mastered the objectives.

Decisions on the degree of product effectiveness are based on an analysis of individual pupil performance on daily in-class assignments, homework, criterion-referenced tests administered as a part of every fifth lesson, and comprehensive pre- and posttests. The daily worksheet analyses provide information on the effectiveness of the specific instructional procedures used in the daily lessons. The criterion-referenced tests provide information on the degree of mastery of the core concepts. The testing procedures also include previously mastered material to check on retention.

7. *The preparation of videodiscs and supporting print materials.* After the prototype videotape and print materials have been refined and their effectiveness demonstrated, the videodiscs and final versions of the instructor manual and the individual student workbook are developed. The prototype videotapes are low budget, half-inch tapes. After field testing with the prototype materials is completed, an investment is then made in the final one-inch, broadcast-quality, master videotapes with high quality graphics, high interest motion footage, and a quality, precisely paced narration. The final videodiscs are made from this one-inch master tape.

This two-stage video production process, with its dependence on success with the more primitive prototypes, is a very demanding development process. It does, however, ensure that the final product is both robust and effective and not highly dependent on the high interest video effects added in the second phase. Too much dependence on such high interest video material could result in novelty effects, disguising and overestimating the true long-term instructional value of the product.

Observations from the Field Testing

The intensive observation of the field-test classrooms was a central strategy in the product development process. We were concerned with data that would guide the product improvement process. A knowledge of student outcomes, by itself, has limited value. Outcome data must be paired with observational data on "teacher-child" interactions to help identify more successful instructional procedures for inclusion in revisions of the product. The following observations were made as a result of this product revision process.

1. *Narration format and student interaction.* In the early field testing, considerable attention was given to the identification of a narration format that was suited to both Level 1 and Level 3. Perhaps the most common narration format used with videotape instruction is the "illustrated lecture" approach. While such an approach has been used successfully with video programs such as the early "Nova" series, where extensive student interaction is not expected or programmed for, it would clearly reduce the possibility of extensive student interaction in either a Level 1 or a Level 3 approach.

Experiments were conducted with a tutorial approach to the narration. This approach was designed to emphasize the highly personalized, step-by-step, question-packed presentation of the expert tutor. While a tutorial approach was well suited to a Level 3 mode, where there was no limit to the system's ability to pose questions and supply feedback, there was some question as to whether it would be successful in the group-oriented Level 1 mode.

In the tutorial format, there were three basic types of student interactions. The most time-

consuming interaction required the group to make individual written responses. The videodisc would stop automatically at a preprogrammed point, with the question posed on a "still frame." When the group was ready, the teacher would advance the videodisc to the next still frame, or series of still frames, that provided the solution to the problem. In some cases the solution would be presented using motion and narration rather than the more space-saving still frames. Motion sequences are necessary to present audio feedback. Motion presentations, however, use up still frames at the rate of 30 per second.

The second most time-consuming type of student interaction was similar to the one just described, except that an oral rather than a written response was required. The least time-consuming, and most common interaction, was one in which a question was posed by the narrator; a short pause was provided for an oral group response, and the disc moved on automatically and provided the feedback. The field testing demonstrated that it was possible to achieve a very high level of student interaction, even with full class groups, through the appropriate mix of these three types of interactions.

Stodolsky (1984) noted that "Pacing is a very central variable in the analysis of instruction." It was found possible to use a fast-paced, highly involved tutorial narration for the Level 1 group presentations. The critical variables were the appropriate mix of types of interactions and the quality of the instructional sequence and associated demonstrations. A poor sequence made even very slow pacing ineffective for ensuring adequate student engagement.

2. *The comparative value of the videodisc presentations.* While few would question the instruction value of videodisc presentations that capture laboratory demonstrations which would be difficult or dangerous to conduct, the comparative value of the less spectacular presentations is often overlooked. Even with simple demonstrations, such as the application of the distributive law in algebra, the advantage over the standard teacher-delivered chalkboard presentation was substantial. With the videodisc, the teacher was able to stand toward the back of the classroom and maintain full control of the class. The loss of class observation and time that occurs when the teacher has to write the problem on the chalkboard is removed. In demonstrating the distributive law, the presentation of the parallel actions of the external term on the terms inside the parentheses was possible with the videodisc. This presentation was made even more powerful when tied to the precisely timed narration. In summary, even with relatively simple instructional presentations, the teacher, using the videodisc, was more in control, was able to present more demonstrations in less time, was able to give higher quality demonstrations, and was able to give more attention to individuals.

3. *Classroom management and mastery learning.* The development of an effective Level 1 delivery system requires that the teacher's behavior be given the same attention as the student's. Dynamic video and well-designed instructional sequences will not guarantee adequate learning by the full range of students found in secondary classrooms. Economical, practical, and effective instructional management procedures must be used for ensuring that individual needs are met when group-oriented instructional systems are used. After synthesizing the research literature on effective instruction, Rosenshine and Stevens (1986) identified the following six "fundamental instructional functions."

1. Review, check previous day's work (and reteach, if necessary)
2. Present new content/skills
3. Guided student practice (and check understanding)
4. Feedback and correctives (and reteach, if necessary)
5. Independent student practice
6. Weekly and monthly reviews. (p. 379)

These six fundamental instructional functions formed the frame of reference for the classroom management practices. These practices were progressively refined during the different field test and revision cycles.

The following specific review, feedback, and correction management procedures were developed as a part of the field test and program revision procedures. Each course has numerous checkpoints for evaluating student

progress. At each checkpoint, the teacher decides whether enough of the students are performing acceptably. If class performance is satisfactory, the next instructional segment is presented. If performance is unsatisfactory, the teacher replays the appropriate earlier segment from a videodisc and then presents new practice problems using still frames. A sufficient number of alternate practice problems are provided on still frames to ensure that student success will be due to conceptual understanding rather than rote memory.

The following checkpoints and associated procedures were found to be effective:

a. *After each new instructional segment from a lesson.* These checks indicate how well initial learning is progressing.

b. *Before the beginning of the next lesson.* This brief quiz is a one-day delay check. The importance of beginning a lesson by checking on the material taught in the previous lesson is well supported by the research literature (Emmer, Sanford, & Clements, 1982; Good & Grouws, 1979).

c. *After every fourth lesson.* This mastery test is a one-week delay check.

d. *At the end of each grading period.* This exam is a multi-week delay check.

In classes, with a wide ability range, this mastery-based system gave field-test teachers the feedback needed to decide how much additional explanation and practice were needed by the students.

4. *Cost and time.* Once a commitment is made to a cyclic process of "field test, revise, and field test," the product developer should be aware that development costs are related to the time and effort it takes to achieve the predetermined levels of student mastery. In the case of the videodisc programs just discussed (Systems Impact, Inc., 1985), one thinks in terms of years and hundreds of thousands of dollars, not months and tens of thousands of dollars.

However, once the commitment and investment are made, the return in student gains is massive. The value of a program that can be implemented at a modest cost, that can be used with a range of learners, and that can be consistently effective is incalculable.

Conclusions

The field testing of the Core Concepts Courses (Systems Impact, Inc., 1985) demonstrated that the combination of interactive videodisc technology, with well researched instructional design and mastery learning procedures, provided the teacher with a flexible and powerful resource. The "core concept" orientation allowed the teacher to provide effective instruction on the most important central concepts to all learners, including those in need of remedial instruction.

In the process of developing and validating a technologically based product, the primary resource should still be the research on the characteristics of effective instruction considered important in any instructional effort (Ragosta, 1983). Characteristics, such as "review of previous learning, demonstrations of new materials, guided practice and checking for understanding, feedback and corrections, independent practice and periodic review" (Rosenshine & Stevens, 1986), will have to be present regardless of the technology used. The product development effort should not stress the characteristics of a specific technology at the expense of proven characteristics of effective instruction (Clark, 1983). Even a technology as flexible as videodisc-based instruction will only be as effective as the quality of the instructional content and associated classroom management practices will allow.

Part 2: The Stress Testing of "Mastering Fractions"

If a product developer seeks assurance that the product will be of the highest quality, the developer does not restrict testing to normal conditions. Indeed, the developer seeks very challenging environments. Two of the ways that an instructional product may be stressed are: (1) placement in a classroom with learners with less skills than the target population, and (2) the use of learners who have a documented history of failure with other products and procedures designed to teach the same instructional content. Both of these approaches were used in the stress testing of "Mastering Fractions."

Stress Testing by Using Younger Students

Every instructional product assumes some entry skills on the part of the student. The more students lack these entry skills, the higher the probability the product will fail. In the case of "Mastering Fractions," the total curriculum is usually completed by the end of the eighth grade. However, substantial portions of the curriculum are often introduced in the fifth and sixth grades.

To ensure that a challenging test was arranged, fourth grade students were selected as a part of the stress testing. To ensure that students were not exposed to unnecessary failure experiences, the implementation was carefully monitored, and the final few instructional objectives were not taught to mastery. The students were taught the objectives typically required for fifth and sixth grades.

The results of the field test are depicted in Figure 1. The subjects were twelve fourth-grade students in an urban elementary school. The students were pretested to ensure that the assumption of limited entry skills was accurate. The average number of students mastering each objective was 90 percent. The skills normally required in the fifth and sixth grades were mastered at well above 90 percent.

Stress Testing by Using Remedial Students[2]

The students selected for this aspect of the product testing were 28 students, approximately half of whom were classified as "remedial" students by the school; the other half of the students were special education students classified as "learning disabled." In this study the product was compared with a more traditional basal program. In order to ensure that the comparative process was indeed a challenging test, the researchers identified a highly regarded comparison product. They then took other measures to ensure that the comparison product was implemented in as appropriate a manner as possible.

The final results confirmed that the comparison product did perform in a very credible manner; however, the "Mastering Fractions" program was clearly superior, and the difference in performance was significant by all accepted measures of statistical or practical significance. The following is a summary of the major aspects of this study.

Experimental Results

The study compared two ten-lesson programs for teaching basic fractions skills. The programs consisted of lessons from the interactive videodisc course "Mastering Fractions" (Systems Impact, Inc., 1985) and lessons from *Mathematics Today* (Harcourt, Brace, Jovanovich, 1985). The skills were writing a fraction from a picture, multiplying fractions, multiplying a fraction and a whole number, identifying fractions equal to one, and adding and subtracting fractions with like denominators. Each program also taught additional skills, which were measured for secondary analyses.

The two treatments were the same in that (1) the two teachers switched half-way through the study, so that each teacher taught half the students for half of the study and the other students for half of the study; (2) the total instructional time was the same each day, and the amount of time spent on concept development was comparable each day; (3) the same major skills were the focus of both treatments; and (4) the same reinforcement system was used with both treatments.

The program differed in two major ways: the delivery medium (videodisc versus textbook) and the instructional design The videodisc has capability for dynamic video and audio, automatic stops, still frames, and branching. The relevant instructional design features were: explicitness of strategies, degree to which explanations focused on "whys" versus "hows," usefulness of exercises, frequency of review, incorporation of the components of a mastery learning system, and the structure of the lessons.

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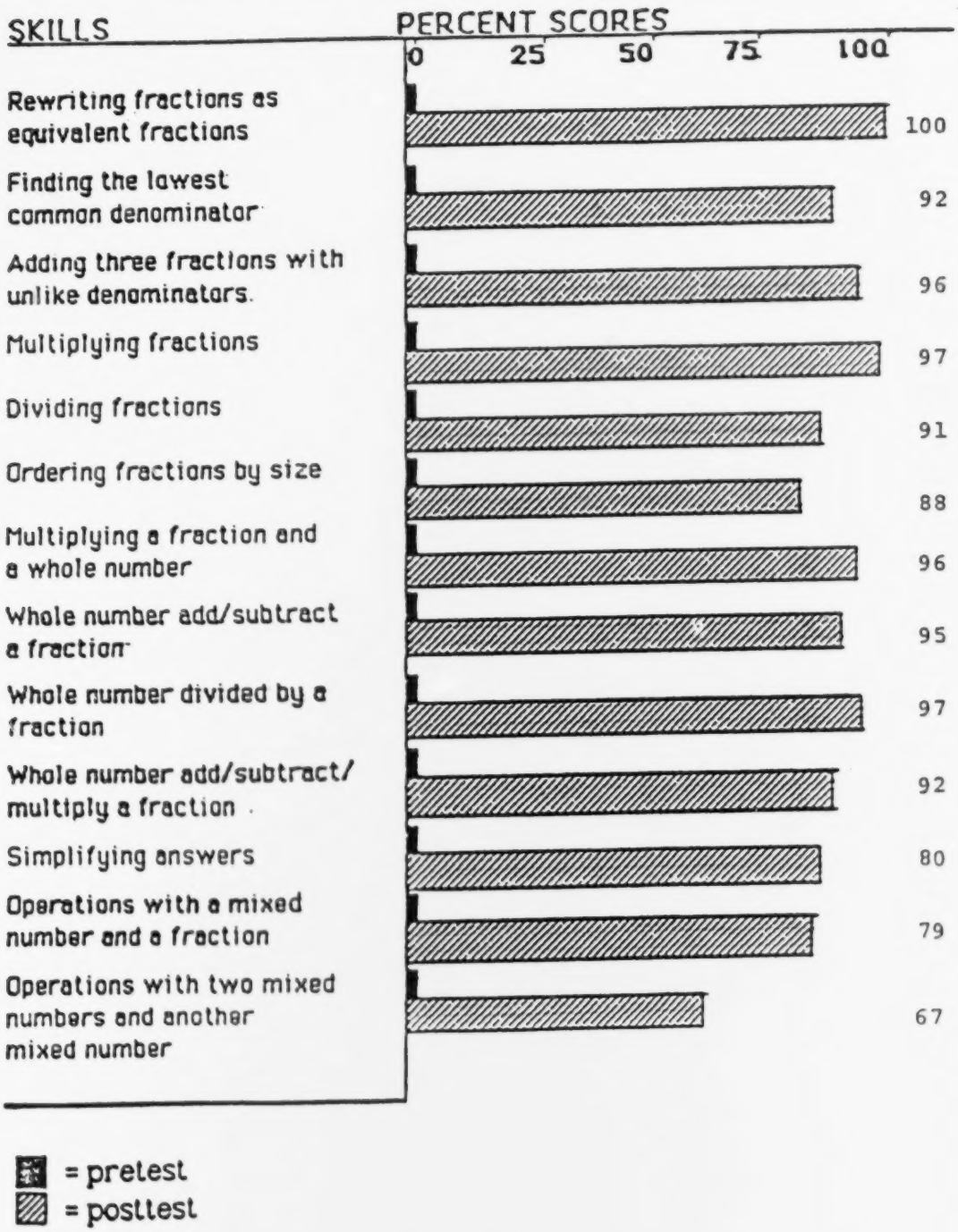
[2]These research findings have been abstracted from material provided by the principal investigator for the comparative study: Bernadette Kelly, Division of Teacher Education, University of Oregon, Eugene, OR 97403

Figure 1


SKILLS
PERCENT SCORES
0
25
50
75
100
Rewriting fractions as equivalent fractions
100
Finding the lowest common denominator
92
Adding three fractions with unlike denominators.
96
Multiplying fractions
97
Dividing fractions
91
Ordering fractions by size
88
Multiplying a fraction and a whole number
96
Whole number add/subtract a fraction
95
Whole number divided by a fraction
97
Whole number add/subtract/ multiply a fraction
92
Simplifying answers
80
Operations with a mixed number and a fraction
79
Operations with two mixed numbers and another mixed number
67
= pretest
= posttest

Students were given pre, post, and maintenance tests on basic fractions skills. The post and maintenance tests had a reliability of over .90. The results are summarized in Table l. The differences between treatments on the posttest and maintenance tests were significant. Students were also given a pre- and post-attitude questionnaire. Three questions dealt with their perceived competence; three dealt with the feeling about the relevance of fractions. The scores could range from -l, very negative, to+1, very positive. The results are summarized in Table 2. Data were also collected on the percentage of six-second intervals in which students were on task. The results, averaged across five sessions, were 96 percent on-task for the interactive videodisc group and 84 percent on-task for the basal group. The level of implementation of the basal group is informally reflected in one of the teacher's remarks. He indicated that the basal class-room was about the best traditional program he had used with handicapped students.

TABLE l
Pre, Post, and Maintenace Scores for Interactive Videodisc and Basal Teatments

Treatment	a (Six Items) Pretest			b (Twelve Items) Posttest			b (Twelve Items) Maintenance		
	%	Num	Sd	%	Num	Sd	%	Num	Sd
Interactive videodisc	42	2.5	.92	95	11.4	1.0	94	11.3	1.1
Basal Textbook	34	2.1	.98	77	9.2	2.3	72	8.6	2.0

TABLE 2
Mean Positive Responses on Pre- and Post-Attitude Measures Concerning Student Competence in and Relevance of Fractions

Treatment	Measures		
	Pretest	Posttest	Gain
Interactive videodisc			
Competence	.08	.81	.73
Relevance	.08	.57	.49
Basal textbook			
Competence	-.20	.58	.78
Relevance	.16	.31	.16

Part 3: Independent Regional Implementation and Evaluations

The following is a listing of school districts presently implementing and evaluating "Mastering Fractions." Other school districts have implemented the product since it became available in December 1985. Only school districts with known formal evaluation components have been included in the following listing.

Rochester, New York. This school district is assessing the product in the regular grades.

Houston, Texas. An evaluation of student and teacher reaction is presently being conducted.

Knoxville, Tennessee. The school district has completed a reviewand has implemented "Mastering Fractions" districtwide in all middle schools.

Lincoln County, Wyoming. This is a districtwide implementation in regular classrooms, remdial programs, and special education programs. The implementation is being evaluated under a grant from the Wyoming SEA.

Logan City, Utah. The district is using the product in JTPA programs.

Davis County, Utah. Both adult education and special education programs are involved.

Jordan Valley, Utah. This district is using the product in high school special education programs in corrections programs.

Carbon County, Wyoming. The product is being used in homebound programs.

Mukilteo, Washington. The majority of use is in regular grades in the middle school.

Olympia, Washington. The product is being used in remedial and special education programs.

Tennessee Valley Authority. The TVA initiated implementations in four states. The product was selected because of the importance of the math skills in industry. The TVA has contracted with Vanderbilt University to monitor and evaluate the implementation.

Las Cruces, New Mexico. This implementation is in a bilingual setting. The implementation is being monitored by staff from the New Mexico State University Center for Rural Education.

University of Florida. The discs are being used in in-service training programs to develop excellence in math instruction.

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VIDEODISC TECHNOLOGY: PROVIDING THE TEACHER WITH ALTERNATIVES

Alan M. Hofmeister, Siegfried Engelmann,
and Douglas Carnine

An Overview of Videodisc Hardware

The phrase "technological applications in education" usually evokes the image of a computer. In reality the underlying phenomenon is the information age, with the computer serving as a major tool. One indication of educators' growing awareness of the breadth and pervasiveness of this underlying phenomenon is the growing use of the term "technological literacy" in place of the term "computer literacy." The influences of other technologies such as videotape, videodisc, fiber optics, and satallite communications are beginning to be recognized as the schools prepare the present school age population for a place in an information-oriented society.

One of the most promising of the new information age technologies is laser videodisc technology. The technology is challenging the LP record in the form of the compact audiodisc; archival use of the computer's magnetic "hard disc" is being replaced by optically read digital discs; microfilm and microfiche storage and retrieval technologies are also being replaced by videodisc-based recording and retrieval systems, and videotape players are being challenged by laser videodisc players.

A Brief Description of Laser Videodisc Technology

A standard laser videodisc looks like a shiny white metallic LP record. The disc stores the same type of information as videotape, but the disc is a random access medium, and each of the 54,000 high-quality, individual frames on one side of the disc can be accessed in a second or two. There is no reduction in the quality of the video image when one moves from motion to still on a videodisc. In the laser reflective format, a low-power laser beam in the player is directed onto the disc surface, where it either strikes a tiny pit or the more reflective surface between the billions of pits etched in the surface. The laser light is then reflected off the surface to a sensor, which detects these variations in intensity of the reflected light. The variations in light intensity, detected by the sensor, are transformed into a signal that is fed to a television receiver. The pits are protected by clear plastic, and only the laser light contacts the disc, resulting in a very robust storage medium and player system.

Instructional Potential

While few have questioned the potential of interactive videodisc instruction to make a major contribution in health, defense, and industrial training, the potential of videodisc-based instruction for the public school has been questioned. Some of the concerns have included the resistance of public educators to technology, the group teaching practices of teachers, the cost of hardware, and the lack of enough quality courseware to support investments in the hardware. The rush by educators to embrace microcomputer technology has demonstrated that educators can and will invest in technology on a large scale. Despite this demonstration of interest in technology, the nature of the public school is such that widescale adoption of videodisc technology may not occur until videodisc-based instructional products are specifically designed to meet the needs, restrictions, and strengths of public school instruction.

In this article, the authors discuss the rationale used to develop videodisc-based instruction in high school mathematics. The videodisc-based products were designed to provide for instruction with a range of learners in a variety of instructional settings, including group instruction and individual instruction.

Classifying Types of Instructional Videodisc Configurations

A widely adopted classification system was proposed by the Nebraska Videodisc Design and Production Group in 1979 (Daynes, 1984). The classification system is based on the "intelligence" levels of different systems. The initial classification scheme included Levels "0" through "3," and that classification has recently been augmented by a Level "4." The different levels are as follows.

Level 0

This system consists of a linear player. Such systems are primarily designed for home entertainment, and have limited interactive functions and many of the same instructional applications of videotape players and movie projectors.

Level 1

The Level 1 players also include quick frame access, freeze frame and scanning functions, two user selectable audio channels, chapter, and picture stops.

A brief description of Level 1 functions.
Quick frame access. There are 54,000 individually addressable frames on each side of a videodisc. A frame can be selected and found using the player's remote control panel. When moving from one frame to another that is a few hundred frames apart, the search time is not perceptible. If the frames are thousands of frames apart, most players will make the change within three seconds at the most. The facility to allow a teacher to branch quickly to any frame from any location in the classroom is a very practical feature.

Chapter stop. The branching may be done by frame or chapter. To access a frame the teacher enters a five-digit frame address or a two-digit "chapter" address. Approximately 70 encoded chapter stops can be placed on one side of a disc. The chapter stop increases the speed and practicality of branching.

Picture stop. A picture stop is a point or frame at which the player will stop automatically. For example, if students are to work a problem in their workbooks after a demonstration, a picture stop will cause the player to stop automatically with the problem showing on the screen. The teacher can then signal the player to advance when the students have completed the assignment. This very practical function allows the teacher more time to monitor pupils rather than be detracted by the operation of the player.

Selectable audio channels. While the entertainment industry typically uses the two audio channels for high quality stereo, the educator can remotely select both or either channel. This is often used when different audio tracks are used for the same visual display, for example, watching the same display in two different languages or presenting a display while posing a problem and then replaying, giving the solution on the second track.

Level 2

The Level 2 player adds the intelligence of an internal microprocessor to the Level 1 functions. The computer code to control the various functions can be placed in an audio track on a disc. Complex combinations of functions can then be conducted automatically or triggered by input through the player's control panel.

Level 3

Systems at this level consist of a Level 1 or 2 player linked to a microcomputer. Such a system will allow both computer and videodisc-generated material to be shown on the screen. In Level 3, the added intelligence and "read" and "write" functions of the microcomputer are added to the wide range of video functions of the videodisc player.

Level 4

A Level 4 system is distinguished from a Level 3 system by the additional power of the microcomputer software. If some type of artificial intelligence software is used, it is usually classified as a Level 4 system.

The Educational Implications of the Different Levels

Of the different levels, Level 1 and Level 3 appear to have the most instructional value at present. Level 3 has received the most attention in industrial and military training efforts. A Level 3 emphasis implies that the instructional institution emphasizes the individual learning station as a major instructional delivery system and that there are resources to support the installation and maintenance of individual learning stations. Some public school districts have the interest and resources to support the extensive use of Level 3 learning stations. However, a large number of school districts are heavily committed to group instruction, with the teacher as the primary instructional agent and technological aid in a range of support roles.

There is a tendency for many in instructional technology to assume that the individual learning station is the most powerful instructional delivery system and that the acceptance of anything less occurs because of a lack of resources. The widespread acceptance of this assumption suggests there is a wealth of research to support the clear, comparative advantage of the individual learning station over other instructional delivery systems. Such is not the case. In their comprehensive review of the research literature on individualized systems of instruction in secondary schools, Bangert, Kulik, and Kulik (1983) reported that group-paced systems "appeared to provide stronger effects" than self-paced systems. The findings do not suggest that computer-assisted instruction and other types of self-paced systems are not effective. Indeed, the findings supported the effectiveness of computer-assisted instruction. The point is that other instructional delivery systems that monitor the individual's progress, including group-paced and systems such as peer tutoring, have been shown to be just as effective as some self-paced systems. Thus, the technologically based individual learning station must not be viewed as the ultimate delivery system for the public school.

The individual learning station is an effective tool that can make an important contribution, depending on the need and resources present in a specific instructional setting (Friedman & Hofmeister, 1984). There may be specific situations were the technologically based learning station may be clearly the best alternative. The rationale for the development of the MECC (Minnesota Educational Computer Consortium) high school videodisc-based economics course was the unavailability of teachers trained in the subject (Glenn, Kozen, & Pollak, 1984). This Level 3 videodisc project was the only available delivery system for some high school students.

The Level 1 videodisc system adds both a massive storage capacity and fast random access facility to the combined instructional functions of the videotape players and film and slide projectors. For this reason, this omnibus medium needs little promotion if we accept the instructional potential of any one of the media that videodisc technology can emulate. In analyzing the different instructional presentation functions possible with different media and media combinations, the combination of Level 1 videodisc systems and individual pupil workbooks results in a very flexible and comprehensive instructional delivery system (Walker & Butler, 1984). For the purposes of this article, a typical Level 1 system will include the integrated use of individual workbook material and videodisc presentations to large or small groups and individuals. In a typical Level 1 system the teacher would spend a large amount of time moving around the classroom checking on individual workbook activities, guiding discussion, and controlling the videodisc player with the aid of a remote control panel. Classroom management and attention to individuals are enhanced when the teacher is not confined to the front of the class.

Because of its considerable flexibility, decisions to implement Level 1 videodisc technology are not tied to the nature of the medium, but to such issues as hardware cost and availability of quality courseware. We have seen a recent decrease in price and size and an increase in the reliability of videodisc players. Quality videodisc players are now available for approximately $500. The availability of a range of quality courseware is, then, clearly, the most important issue. The

development of the Core Concepts series (Systems Impact, 1985) has significantly increased the available alternatives. These videodiscs in math and science have been extensively field tested with a range of high school learners.

Staff Development and Student Achievement

In terms of external appearance, the Level 3 videodisc system and a computer-assisted instruction (CAI) system appear very similar. In reality there are some subtle, yet important, differences between Level 3 and CAI systems. Perhaps the most important difference is in the degree to which the two systems can emulate the instructional presentations of effective teachers. In the past, CAI has not tried to model the classroom presentation practices of the effective teacher. The cost and complexity of generating the graphic visual displays and the associated audio have limited the ability of CAI to emulate the dynamic instructional procedures of the teacher. CAI has, instead, relied on the instructional presentation practices of programmed learning. Programmed learning's extensive use of the single-frame, immediate feedback, and the extensive use of text to communicate are much more suited to the capacities of microcomputers presently being used in the schools. These programmed learning approaches being used in some CAI programs have clearly been effective in meeting their primary purpose of instructing students (Bangert, Kulik & Kulik, 1983; Fisher, 1983; Hartley, 1977). The problems of instruction in some high school students are not limited to the need to teach students. Ewell (1983) reported:

> Math teacher scarcity is so great that even when compared with the "traditional shortage" of physics teachers, it ranked higher.
>
> The roots of the problem go even deeper. A study by the NCMT indicates that last year 25 percent of math teaching positions were filled by uncertified instructors or those holding only temporary certificates. According to Max Sobel, president of the 45,000-member teachers' organization, this rate approached 50 percent in some areas of the country! (p. 36)

If an instructional delivery system can both instruct students and model the presentation practices of effective instructors, then its cost effectiveness will increase significantly in subject areas where staff development and student achievement are both important. Of the technological alternatives presently available, interactive videodisc instruction appears to be the one best suited for modeling effective teaching presentations and increasing student achievement.

Dual Level Videodisc Courseware

It is possible to design videodisc-based courseware that can be used in both Level 1 and Level 3 systems (Jonassen, 1984). Kessinger (1984-85), in his in-depth review of MECC's videodisc-based economics course, reported:

> MECC originally designed Introduction to Economics for those smaller high schools unable to offer economics as a regular class. One could simply set it up in a media center and allow students to work through the course at their own pace. Yet it is quite likely that this MECC package will be of interest to teachers in larger schools. These materials can be used with the whole class in a discussion format to introduce topics with precise control and immediate feedback under teacher direction. I have used a similar approach with middle school students. It worked smoothly, and the level of discussion from first period in the morning to the last period of a teaching day was high. And it was fun. In most cases, Introduction to Economics will work with individual students, small groups, and entire classes. (p. 37)

Effective Instruction and the High School Learner

The point has been made quite forcefully by Clark (1983) that the medium serves as a vehicle for instruction and that the instructional methodology will be the important variable in

determining the effectiveness of the instructional product. The components of an effective instructional methodology were summarized by Ragosta (1983). In reporting on a successful longitudinal study of a CAI project, Ragosta stated:

> The success of CAI in this study may be related to the successful practices identified in other effectiveness studies: mastery learning, high academic learning time, direct instruction, adaptability and consistency of instruction, an orderly atmosphere with the expectation of success in basic skills, the use of drill, and equal opportunity for responses from all students with a high probability of success in responding. (p. 124)

In addition to the above-listed components of an effective instructional methodology, consideration must be given to the specific characteristics of the high school learner. In mathematics, in particular, a significant percentage of high school students will display a range of inappropriate learning strategies. The observant high school teacher is very much aware that the teacher must not only plan instruction to teach new material, but also counter the attitudes and learning habits resulting from past unsuccessful experiences with the subject.

There are two main types of inappropriate learning behaviors that instruction must counter. The first is an unwillingness to follow directions in lieu of alternative student-generated procedures, which could range from using their own "short cuts" to copying the answers from their peers. The second is the emphasis on single-case problem solving at the expense of developing general problem-solving strategies. Too often the unsuccessful student fails to recognize a problem as a member of a class of problems. A student cannot hope to achieve conceptual depth in a subject area, such as mathematics, if the basic problem types are not recognized and the problem-solving rule or rules for the problem class are brought to bear on the problem.

If instructional procedures are to counter these two main types of inappropriate learning behaviors present in many high school learners, the teacher must first restore the student's confidence in instructional directions. As Rosenshine and Berliner (1978) and Ragosta (1983) noted, a "direct" instructional approach is needed. Clear specific directions, which make the problems and the problem-solving steps explicit, are essential. Long-winded "interest building" introductions that disguise the problem and leave the problem solving to student trial and error may have some value for the successful student with well-developed problem-solving skills. Such procedures will, however, compound the problems of the unsuccessful students, who will need explicit problem-solving strategies and numerous consistent demonstrations of success before they will consider instructional directions worth their attention.

Developing generalizable problem-solving strategies, instead of the rote learning of individual examples, requires carefully managed instructional sequences in which problem classes and their associated rules are carefully introduced, practiced to mastery, and reviewed. The Level 1 and the Level 3 interactive videodisc systems are ideal vehicles for ensuring the careful control of the instructional sequence, while at the same time ensuring that there is flexibility to allow faster learners to move through only the material they need to cover.

Conclusion

In summary, the range of resources and instructional needs present in public high schools suggests that the Level 3 learning station approach, so popular in other areas such as industrial training, may be too narrow a delivery system. Videodisc-based courseware can be designed to work effectively as Level 1 and Level 3 delivery systems. This dual-level approach to videodisc-based courseware development appears consistent with the range of resources and instructional needs present in public high schools. The dual-level approach appears particularly well suited to math and science instruction, where both student achievement and staff development are of major concern.

The flexibility of interactive videodisc technology can allow the instructor to adapt instruction to the needs of a wide range of learners. The potential exists, even with Level 1 systems using individual pupil workbooks, to provide both very structured learning sequences for the slower learner and still meet the needs of the more successful student.

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PREPARING TEACHERS FOR LEVEL III: INTERACTIVE COURSE MATERIALS FOR GRADUATE INSTRUCTION

Janet L. Bohren and Marjorie A. Cambre

Introduction

This presentation is intended for educators interested in designing and implementing an interactive video course for graduate programs. Interactive videotape teaching modules developed for a graduate interactive video course taught at The Ohio State University and a sampler of typical student projects will be described.

The Graduate Course

Interactive Video for Instruction, a graduate course in the College of Education at The Ohio State University (OSU), offers students the opportunity to explore and design educational applications for interactive videotapes and videodisc. The course includes an overview of the technologies involved and the teaching/learning theories and research that support the strong potential of this new medium. The emphasis is on Level III programming, i.e., making existing video materials (tape and disc) interactive.

Students study and work with interactive video design models, authoring systems, and languages in the development of their own interactive videotape or videodisc lesson. This process gives graduate students hands-on experience with the design and production of interactive videotape or videodisc programs.

The course draws both graduate students and faculty members from a variety of colleges at OSU (e.g., education, allied medicine, communication, agriculture, and home economics). Foreign students from Taiwan, Japan, Saudi Arabia, and other countries have taken this class. The course can serve about 20 people per quarter and is taught winter and spring quarters. Students attend one, two-hour lecture and are expected to spend a minimum of three hours in the lab per week. All students spend much more than this minimum time in the lab, as the major thrust of the course is the development of two instructional design projects. Project l is done by pairs of students. The purpose of project l is to give students experience designing and producing a short (five minutes) interactive videotape lesson using a pre-produced "linear" video program. The second project is done individually. Each student is to design a ten-minute lesson, focusing on the creative use of the interactivity afforded by the technology. There is a variety of videotapes and videodiscs for students to use in the Edgar Dale Media Center at OSU. Students are discouraged from producing their own tapes, as it is preferred they spend their time designing and developing an excellent piece of interactive instruction rather than on video production..

Level III systems available for our students to use are:

For videodiscs: Discovision model PR-7820 connected with a VMI interace board to an Apple II+, and AMDEK color 300 monitor.

For VHS videotapes: Panasonic AG-6300 with a panasonic color monitor, Apple II+, Apple green screen monitor, and BCD Model 450 VTR control interface.

For Beta videotapes: Sony videocassette recorder with AMDEK color-I monitor, Apple II+, Apple green screen monitor, and BCD Model 450 VTR control interface.

Authoring languages: BCD authoring system (Instructor and Logger)
BCD SuperPilot Library Routines

Student knowledge of programming languages and authoring languages varies. Most students are encouraged to do their first project using the BCD authoring system. On their second project, students may use BASIC or Pascal to develop interactive video instruction with a videodisc. Marty Grant, a graduate student, developed a simple manual that enables students with minimal knowledge of BASIC to do their projects with videodiscs, using BASIC to author their lesson. Those students who already knew SuperPilot when they entered the course often chose to use SuperPilot to author their instruction. The majority of the students chose to do both projects using the BCD authoring system and one of the interactive videotape systems. The BCD instructor and logger are somewhat confusing and frustrating to use at first, but most students mastered them by the end of the first project. In spite of the limitations of the BCD authoring system, students developed some very creative instructional projects. Students were also encouraged to design one or two graphics pages using the Koala Pad and the program AlphaPlot (to add words to their picture).

General Philosophy of the Course

One of the challenges for educators in a technological culture is to understand and manage the constant infusion of new technologies and their accompanying software and courseware into the school and classroom. Historically, new technologies have been accepted in the commercial area before educators adopt them for their purposes. Often the "adoption" takes place before educators and/or producers are ready to adapt the commercial products to quality educational materials.

Educators are in a unique position vis-a-vis interactive video. This technology represents the interfacing of two currently flourishing technologies--video and microcomputer--into a third powerful and educationally exciting medium. The technology is still new and scarce enough that educators can have an effect on the direction it takes as it slowly penetrates the school marketplace, as it is certain to do.

To facilitate and model the interactive process, interactive videotape modules were developed to teach instructional units in the course demanding skills in the use of the equipment and software, thus freeing lecture time for presentation and discussion of instructional design theory.

It is important to recognize that interactive videotape and interactive videodiscs represent two separate and important uses of technology available to educators today. Granting the random and more rapid access to information that videodiscs offer, it is important to remember that in schools today there are very few videodisc players. Videotape and VCR's are very common and available to most teachers at all grade levels. In addition, students and teachers can produce their own videotapes for instruction, thus personalizing education. Videotapes also can be edited and updated easily and inexpensively compared to videodiscs, thus enabling teachers interested in using this technology to modify and change their instruction easily and relatively quickly.

Conclusion

Building on knowledge gained from instructional television and the design of computer-assisted instruction, it is important to illustrate to teachers in graduate schools of education today the opportunities available to them to bring the excitement of both videodisc and videotape technology to their classrooms.

TEN USES OF VIDEODISC IN PUBLIC SCHOOLS

Robert L. Blodget

Introduction

Today, with the complexity of educational issues, it is easy to lose sight of the simple fact that at the heart of education is learning, and central to learning is access to quality information and ability to interact with that information in a meaningful way. Now, both teachers and students are having greater access to information through the use of laser disc technology.

Laser Disc Uses in California

Laser disc is of particular value to education because it is a durable medium, has a vast storage capacity, and its stored information is quickly and easily accessible. As a result, in California, a number of schools are implementing the use of laser disc technology in classrooms, libraries, and computer labs. In some schools, officials are placing laser disc players with computers on carts as audiovisual systems. In other schools, educators are using the players as second disk drives connected to computers in the computer lab. In a number of elementary schools, laser disc machines are placed on tables in individual classrooms to be used as activity centers. In most cases, the machines are used by both teachers and students.

In general, school personnel are using the laser disc systems in ten ways.

1. The systems are used to provide quick and easy access to information. In this way, the systems are used almost like an encyclopedia. For example, paintings by different artists can be examined on the National Gallery of Art disc, or films on storms can be viewed from an earth science disc by students who are studying weather.

2. Laser discs are being used to provide clear demonstrations. A demonstration on origami can be watched in slow motion. It can be paused at critical points. Sequences can be easily and quickly reviewed.

3. The laser disc technology is ideal for presentations. Using an authoring system, computer, laser disc player, computer monitor, and a color monitor, a teacher can put lecture notes on the computer monitor and use it like a teleprompter, while having the computer call up the appropriate corresponding audiovisual material to illustrate visually the lecture points. For example, when giving a talk on insects, a teacher can read a lecture from the computer monitor while the corresponding slides of insects are shown on the color monitor.

4. In a similar fashion, the system is often used to provide material for student study. Students who have missed class, or who need to review, can read the lecture material while viewing the audiovisual information. Many teachers are creating their own study material for students. For the first time teachers can quickly and easily create their own lesson material drawing upon a library of visual aids.

5. In a few schools, teachers have gone a step further and have used an authoring system, laser disc player, and computer as a curriculum development work station to create handouts, workbooks, overhead transparencies, and other teacher-generated materials.

6. Some teachers have chosen to transfer audiovisual presentations that they create to videotape. An authoring system connected to a laser disc player is ideal for producing and editing videotapes. Some laser disc publishers give schools the right to use the laser disc as an audiovisual data base for videotape production for use within a school. This capability is ideal for pulling together topical information spread over several discs.

7. Many teachers use the laser disc system to provide tests or assist in testing students.

For example, during a group test, the teacher might show a segment of cell division and ask the students to identify the phase. For individual testing, the student might take a whole test right at a computer connected to a laser disc machine. An authoring system can enable a teacher to select materials to show the student, and can further enable the teacher to ask multiple-choice, true and false, and fill-in-the-blank questions.

8. Because an authoring system used with a laser disc system can enable a teacher to present material, ask questions, and respond according to the student response, one of the uses of laser disc in which there is a great deal of interest is the capability for teachers to provide interactive lessons and activities. For instance, in order to help fifth-grade students understand classification, one teacher created an activity where students were shown pictures of different organisms and asked to identify common shared characteristics. Depending upon the student response, the teacher programmed the system to ask more probing questions or branched to show more illustrations.

9. Teachers have found laser disc equipment connected to an authoring system to be useful for student projects. Two fifth-grade girls wrote a report on interdependence. They selected pictures from a bio-science disc to illustrate their points. One of their classmates was studying mammals. This student went through a collection of slides of mammals on the bio-science disc and identified and classified them. A high school sophomore, using the same disc, wrote a report on the organisms he found while studying the ecology of a local creek.

10. As students have begun using the laser disc system, teachers have found it to be a useful tool for introducing them to the principles of programming. By using an authoring system connected to a laser disc player, before getting into the nitty gritty of learning the vocabulary of a language, students can learn about branching, if-thens, loops, etc., quickly and easily, with interesting results.

Conclusion

The unique feature of laser disc over other media seems to be the ability to maintain control over access to vast amounts of audiovisual information. Although some school officials have purchased laser disc players to be used by themselves (as level one systems not connected to a computer), and in some schools they have purchased systems for playback of pre-canned material (level two systems), the emerging trend seems to be that teachers are more and more using the laser disc system's ability to provide management of information in order to adapt material to individual goals, needs, teaching styles, and preferences.

THEORETIC FRAMEWORK TO EXAMINE ISSUES OF INTERACTIVE VIDEODISC APPLICATIONS IN PUBLIC SCHOOLS

Ronnie B. Lowenstein

Introduction

This article was the basis of a presentation delivered at the 1986 Nebraska National Videodisc Symposium for Education, sponsored by the National School Boards Association and The University of Nebraska. In this article, it is proposed that the overriding issue of IVD applications in public schools is how one thinks. Stakeholders of technology and education are urged to honor the diversity of perspectives involved in the development and implementation of interactive technologies and shift thinking to context. Two conceptions of IVD compatible with concerns for social interaction and context, one as a media technology, the other as an innovation are presented. Finally, a non-linear theoretical model I-T-E (Individuals-Technology-Environment) is presented to help stakeholders incorporate understanding of the complex, dynamic interrelationships of IVD technology in public schools (see Figure 1).

Participants at the National Videodisc Symposium for Education represented a wide variety of levels of concern and diverse role responsibilities related to media and education. Daily decision making of participants reflected that diversity; some participants created policy guidelines for research, instructional design, resource allocation, and/or staff development. Others, who worked directly with students in the classroom, focused on decisions relating to classroom management, curricular content, and strategies. Yet, educators shared some common bonds, specifically, an interest in the instructional applications of interactive videodisc technology, a dedication to the future of public schooling, and, perhaps, some discouragement regarding the discrepancy between claims of IVD potential and the school reality.

Many of our experiences with public schooling validate the remarks of Former Secretary of State, Henry Kissenger, when he addressed the United Nations General Assembly in 1973: "Technology daily outstrips the ability of our institutions to cope with its fruits." This appears to be particularly true for the institution of public schooling. History reveals that, unlike media use in the military and in private industry, media use in the public schools has been disappointing. IVD technology appears to be following a discouraging pattern, similar to that of prior technologies, the microcomputer and television. The recurring scenario is as follows.

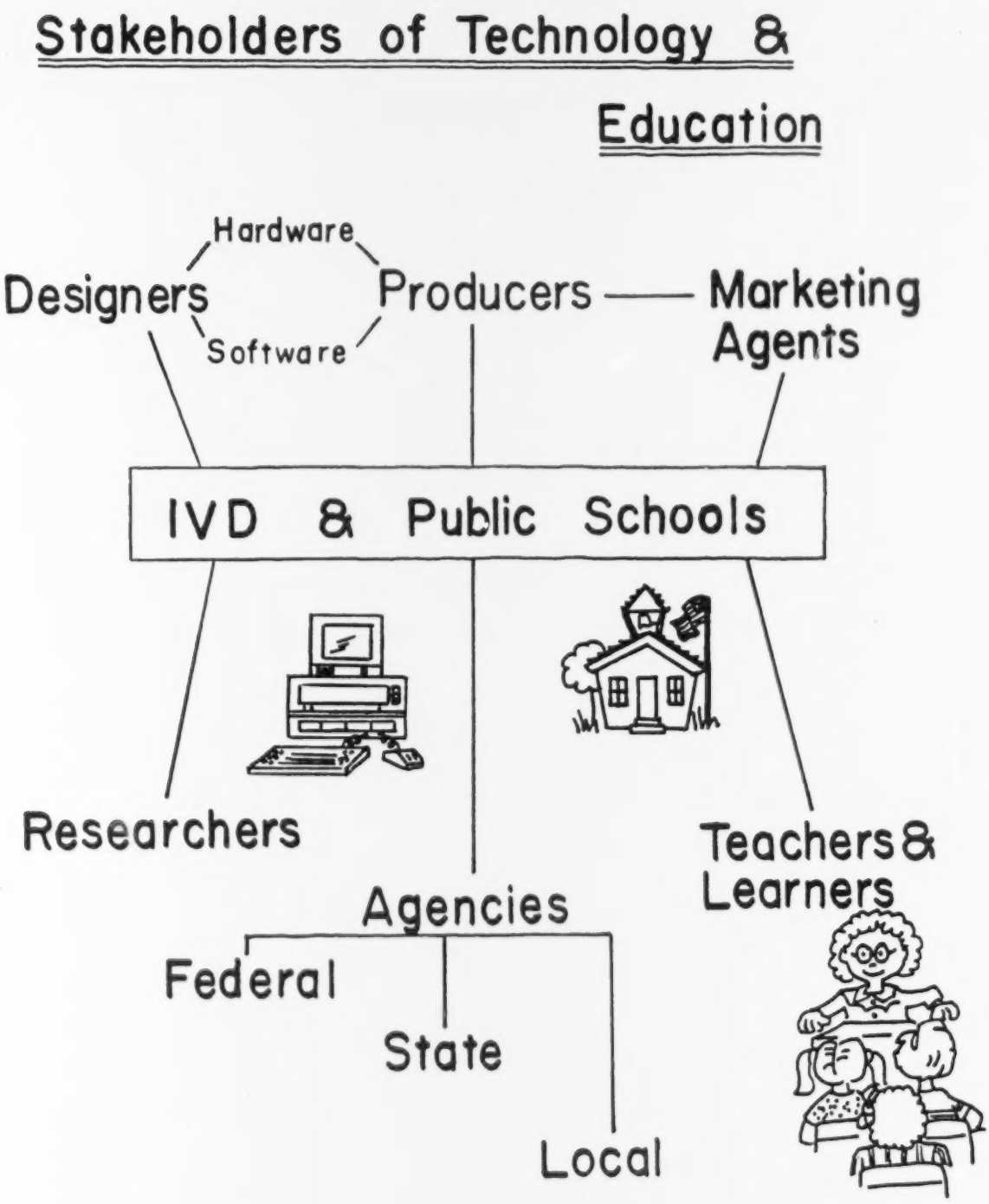
The technology emerges amidst fanfare. Proponents hail its value as an instructional tool. Some claim that it is a panacea for education, capable of curing whatever ills society deems most prevalent. In some schools, it is quickly embraced and introduced. The teachers are expected to adopt the new technology, no matter how compatible it is to their philosophy, goals, or teaching style.

As implementation proceeds, the increasing presence of the technology begins to change the way some people think. But, in reality, in practice, little really changes in the schools. Traditional patterns of teaching, learning and organizing schools remain constant.

In time, people recognize that the claims of potential of the technology have failed to be achieved on a large scale. They begin to note the ambiguities and lack of clarity regarding (1) the nature of the technology, itself, (2) its appropriate instructional role, and (3) the strategies necessary to successfully implement it. Finally, perceptions develop that the media technology has failed.

Why does this occur? Why is the ability of the public schools to assimilate new technology

Figure 1


Stakeholders of Technology & Education
Hardware
Designers
Software
Producers
Marketing Agents
IVD & Public Schools
Researchers
Agencies
Federal
State
Local
Teachers & Learners

a far greater problem than the development of the new technology (Seidel & Ruben, 1978)? And how can persons, aware and concerned with the current and future conditions in education, alter this discouraging pattern of media use?

Shift in Thinking

Perhaps one can take a lesson from the biologists concerned with ecology: To study and understand a frog specimen, they examine it both in laboratory isolation and in the context of the pond.

The pond of exploration for IVD technology is the institution of public schools. Perhaps, for the potential of IVD technology to be effectively harnessed within the public schools, persons need a shift in their thinking to context. Rather than examining the "gee whiz" of IVD in isolation, persons might be more successful exploring IVD within the context of the institutions it serves. Whether one deals with decisions related to priorities for research, guidelines for design, resource allocation, or strategies for classroom instruction, etc., an attempt should be made to eliminate traditional linear, cause-effect thinking that has proven inadequate and replace it with non-linear, interrelational thinking. In so doing, one can more easily honor the diversity of perspectives of the various stakeholders and take into account the complex dynamics among them.

The pragmatists are now questioning how this can be done. In the remainder of this article, the author will describe a theoretical model that can serve as a guide to relational thinking about IVD technology within public schools.

Building a Theoretical Model

The model, called "I-T-E: Lowenstein's Model of Reciprocal Determinism," is based on social learning theory and adapted from the Salomon-Bandura model. It is a reciprocal paradigm that emphasizes the dynamic, interdependent, and reciprocal relationships between individuals (I), their environment (E), and the technological factors of the videodisc (T).

Individual classroom teachers are the stakeholders closest to the student. The classroom teachers in the 16,000 school systems across the country possess a wide variety of attitudes toward and knowledge about IVD technology and its potential applications. For purposes of this article, it was assumed that most teachers are inexperienced within the technology itself but eager to understand the enthusiastic claims about it.

The first question appears simple: What is IVD technology? This proves to be a difficult question to answer. Technological evolution has occurred so rapidly in the last twenty years that descriptions are wrought with ambiguities. Further, the vagueness in descriptions has been compounded by the development of "intelligent" interactive discs, which some authors have described in terms of hardware, some in terms of software, others in terms of philosophy and instructional function. Some exasperated, critical thinkers have even been heard to describe interactive videodiscs as a solution in search of a problem.

The term "videodisc" was first used in 1971 (DeBloiis, Maki, & Hall, 1984); over the years the concept has evolved. Currently, the definition that has gained wide acceptance expresses a user's point of view: IVD represents a fusion of the computational power of the microprocessor with the massive optical storage capacity of the videodisc. Further, what has been widely adopted throughout the industry has been the classification system categorizing videodisc system capabilities first proposed by the Nebraska VideoDisc Design and Production Group in 1979. In that system, distinctions are drawn according to the level of "intelligence" of the system: Levels 0-4 indicate increasing levels of sophistication in programming design (software) and functional capabilities of the player (hardware).

However, mere descriptions of hardware and software components fail to express the totality of IVD technology. According to educators (Bork, 1985; Gayeski & Wililams, 1983; Jernstedt, 1982), technologists (Hon, 1983), and theoreticians (Salomon, 1979), the most significant aspect of IVD is its "interactive" nature. Alas, interactivity itself is

Figure 2

Lowenstein's Model of Reciprocal Determinism

(adapted from social learning models of Salomon-Bandura)

T: technologies

(IVD Attributes)
- Quality
- Accessibility
- Availability
- Compatibility

I: individuals

(Teachers & Learners)
- Knowledge
- Skills
- Attitudes

E: environments

(Public Schools)
- Climate
- Support Mechanisms

a very general concept! When interactivity is applied to instruction, it involves multiple components or straetgies whose relationships to learning are little understood (Mackenzie, 1986).

Perhaps, a problem with each of the descriptions is narrowness. When technology is referred to as if it were a single entity, its complexity and context of use are ignored. A more appropriate definition of IVD is suggested by media theoretician, Salomon (1979). He described all media as possessing four classes of attributes: (1) contents which can vary in format and message; (2) the multiple symbol systems of print, film, graphics, and sound used to convey contents; (3) the variety of transmission technologies; and (4) the differing social situations within which the media operates. Salomon argued that the effect of each class of attribute bears a distinct, if sometimes subtle, influence on the cognition of individuals and their learning within different environments. Application of his perspective to IVD acknowledges the complexity of the totality while providing a framework for dealing with each of its parts.

Is this more inclusive definition sufficient for educating classroom teachers? Perhaps not. As technologist Hon (1983) conjectured: "The defintion of IVD may be as existential as Louis Armstrong's definition of jazz: 'If you have to define it, you ain't got it'" (p. 22). It appears that to understand jazz or IVD, one needs to experience it directly.

Even when classroom teachers experience IVD directly and intuitively understand its potential, there are multiple barriers to teacher acceptance and successful utilization. For the teachers, IVD becomes more than a new technological tool for delivering instruction; it represents "innovation," a process that demands development of new skills and new beliefs. The teachers must learn not only to manipulate the new hardware, but more importantly, they must learn how to integrate the new interactive software content into their repertoire of curricular strategies. Something significant is happening. Interactivity between student and machine tends to shift the focus of responsibility for learning toward the learner and away from the teacher. This shift is a challenge to the traditional role of teachers as the main disseminators of information. The curricular integration of interactive technologies actually involves a shift in the traditional teaching/learning paradigm (Gagne, 1980). Acquiring new expertise, as well as new "psychological scripts" (Shavelson & Von Blum, 1985), is difficult for most people. Classroom teachers perceive the implementation of IVD as demanding changes in teaching practice and changes in pedagogical beliefs. No wonder that many teachers view emerging technology, such as IVD, as a "potential loss of perceived expertise" (Romberg & Price, 1981, p. 10). Or that those teachers attempting new skills and roles at the same time often suffer from "role overload" (Gross, Giacquinta, & Bernstein, 1971, p. 49).

Recognizing the stress of change on teaching staff prompts questions: What does it take to convince teachers all this change is worth the effort? What are the incentives for teachers to become aware, to develop new skills, to incorporate new software, to give up some control, and to risk new performance strategies? Once teachers become convinced that IVD is a valuable tool for accomplishing their goals of instruction and worth such efforts, what next? What kind of impact can teacher-led support of IVD have within a school system?

Teachers do not operate alone, but rather within a complex sociocultural context. The context of public schools has been described as a series of loosely-coupled, nested subsystems; the classroom operates within a school, which operates within a school system, which operates within the local community, which operates within a state within the nation. The various levels of the system often act, not as a coordinated, integrated problem-solving mechanism, but rather as a combination of independent, self-interest groups, all competing for scant resources (March, cited in House, 1982). The policy decisions related to technology emanate at the higher levels and are often politically rather than instructionally motivated. It appears that the traditional organization of schools and the cost factors of IVD technology mitigate against a bottom-up swell of teacher-led support for videodiscs.

In an optimistic scenario, where there is top-down support for IVD technology, one can assume creation of policy that supplies classroom teachers with IVD systms appropriate to their curriculum and instructional goals along with opportunities for staff in-service training. Yet, such provisions, while necessary, remain insufficient to insure successful classroom implementation. Bureaucratic decisions at the upper levels will determine what resources are available in the classroom, but ultimately it is the daily decisions of the individual teacher that determine how the resources are used. Since perception is what controls behavioral responses (Anderson, 1982), the individual teacher's perceptions of the environment become a significant factor in successful IVD applications. Because the environment is composed of many elements and subsystems, both internal and external to the class and school (Webster, 1972), the impact of environment on IVD utilization is complex.

Teacher perception regarding the environmental climate is determined by multiple factors, not least of which are the actions of the principal within the school (Leithwood & Montgomery, 1982). For principals and other administrators, introduction of IVD represents major organizational innovation.

As research has demonstrated, *educational* innovation is a slow process, composed of multiple interactions that take place over time and encompass social and cultural dimensions (Fullan, 1982). The policy decisions to introduce *technological* innovation into public schools become ambitious attempts to change both individuals and organizational structures within the very complex institution that has been inherently resistant to change (Berman & McLaughlin, 1978; Fullan, 1982; Goodlad, 1976; Oettinger, 1969; Romberg & Price, 1981). Introducing *interactive* technologies is even more difficult. In fact it is considered by some to be revolutionary; the interactive technologies encourage the development of systems that disturb institutional and professional relationships in poorly understood ways (Heinich, 1984).

Conclusion

It becomes increasingly clear that the reality of introducing IVD within public schools is complex. Successful implementation will be dependent upon many interrelated factors and decision points that affect individuals and systems alike. Prior research on innovation and change has identified linear lists of barriers to successful utilization of technology (Gross, Giacquinta, & Bernstein, 1971; Seidel, Hunter, Kastner, & Rubin, 1974; Sheingold, Kane, Endrewiet, & Billings, 1981). However, linear lists fail to accommodate interrelational processes that occur within a complex sociocultural context.

Recognizing this, stakeholders are challenged to shift their thinking to context and social interactions in the successful use of media technology in education. Perhaps the model of I-T-E can help guide holistic thinking as persons search for answers to the following questions:

> How can school systems innovate in a way that accounts for interrelational concerns?
>
> What long-range, systematic plans can be created to develop a supportive climate for change?
>
> What formal and informal mechanisms can be established that provide classroom teachers with the appropriate hardware/software, staff development, and incentives and rewards that encourage them to innovate and risk new teaching/learning paradigms?

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RE-PURPOSING NASA VIDEODISCS

Alan D. Evans and Brian Callahan

Introduction

Two basic assumptions are posited in this article: (l) discs cannot be mastered as often as one would like, and (2) there are many outstanding discs available that can be re-purposed. To re-purpose videodiscs for instruction, several steps are required. First, the portions of discs that relate to the school curriculum must be identified. Second, interactive video lessons must be designed and written. Such a project is explained in this article.

Resources

Outstanding visual and audio information of various NASA space missions is available through Optical Data Corporation (formerly Video Visions). The four discs currently available are: *Astronomy, Earth Science, The Sun, and Voyager*. The VAI II interface that sells for $140.00 and a simple authoring system called Laser Write are also available from that source. Laser Write is currently available in version 3.0 and sells for $75.00.

A graduate level interactive video class is offered at Kent State University each fall, in which students learn how to design interactive video lessons and the use of the Laser Write authoring systems. Students who had completed this class were eager to author interactive lessons that would be useful in their schools.

Computer lab space was available during the summer of 1986 in the Euclid Public Schools, and this space was volunteered as a site for authoring activities.

Videodisc players and interactive video interfaces are currently loaned to northeastern Ohio schools through a program sponsored by WVIZ-TV Cleveland (PBS). The station offered the equipment for authoring and agreed to disseminate the interactive video lessons to area schools.

Opportunity

An opportunity arose to create interactive video lessons using the NASA videodiscs, the VAI II interface, and Laser Write. Such a hardware system is relatively inexpensive and, therefore, could be widely adopted. Furthermore, there was the opportunity to disseminate these interactive video lessons through NASA, Optical Data Corporation, WVIZ-TV, and Kent State University.

Implementation

A plan was prepared and six persons who had completed the interactive video class were identified and matched with six persons who were science/content experts. These persons worked for a week to author interactive lessons. Funds were provided by NASA to sponsor the week-long workship, and two sets of the video discs were provided by Optical Data Corporation at half price as part of an authoring agreement.

The project director provided an instructional design approach for the authors and selected a single monitor format for the lessons. A format for instructors' guides was also provided.

Outcomes

Six interactive video lessons were developed. At the present time, these lessons are being evaluated and refined. A continuing activity includes collecting feedback on program use, strengths and weaknesses, and teacher and student satisfaction. This project was conceived and conducted as a pilot effort which should guide future re-purposing of videodiscs.

LECTURING WITH VIDEODISCS

Larry D. Kirkpatrick

Introduction

Videodisc technology provides teachers with an excellent lecture aid that allows audiovisual material to be customized for a specific teacher and a specific class of students in ways not possible with any other medium currently available.

Many teachers are not satisfied to simply show an entire film or filmstrips. They like to omit certain sections and emphasize others. Or, they may wish to play one part during one class period and other parts during subsequent periods. The interactive videodisc technology is extremely flexible in this regard.

If the usage is simple, such as playing a part of a film or showing a group of consecutive frames as a slide show, the player is easily controlled by the remote control unit. However, if teachers wish to play several sections of film, rearrange the sequence, or choose individual scattered frames for a slide show, they must spend valuable class time keying frame numbers and instructions into the player. In this latter case, the player can be profitably controlled by an external computer.

The Program

A program has been written, which is described in this article, that allows teachers to communicate with the videodisc player in ordinary English. Furthermore, the computer display shows the current status of the player, and indicates what will happen next. The use of an external computer has the additional advantage of being able to store the commands on diskette for later retrieval.

As an example of the use of this program, consider the following simplified lecture presentation using the *Voyager* videodisc. The information provided on the computer monitor is shown in Figure l. After the program is loaded, the teacher types LOAD JUPITER. This command is shown after the lower KB near the bottom of Figure l. The KB section on the monitor displays the last three commands typed into the computer. The LOAD command tells the computer to read the text file JUPITER from the floppy diskette and begin to execute the commands that have been stored in the file. The word COMMAND near the top left corner of the monitor indicates that the command file has control of the player. Other options are KEYBOARD, REMOTE, and EDITOR.

```
                    VOYAGER

  COMMAND                              AUDIO 1
BEGIN  CURRENT   END     DIR    SPEED
10071    12000   14095   FWD      30

  1 INITIALIZE VOYAGER
  1 DELAY 0
  2 FIND 426 < FIND FRAME WITH
    LOGO
  3 AUDIO 1 , LEFT CHANNEL ONLY
  4 PLAY 10071 TO 14095 < JUPITER
    MOVIE
  5 FIND 421< BEGIN SLIDES
  6 JUMP 1  6 TIMES
  7 JUMP 10
  8 JUMP -1 3

  KB
  KB
  KB LOAD JUPITER
```

FIGURE l
The Monitor Screen

The first command in the file is INITIALIZE VOYAGER. The computer prompts the teacher to load the videodisc entitled *Voyager* into the player and to press any key when finished. Then the computer initializes several default settings in the player

and starts the videodics spinning. Only the first letter of any command need be used. In this case, the program ignores the remainder of INITIALIZE and uses any following words as the title of the videodisc.

The second command is DELAY 0. This tells the program to stop after any search for a specific frame or at the end of any playing sequence. The program does not continue until the teacher presses a key on the keyboard. Allowing the use of any key makes it easy to use the computer in a darkened room. DELAY 0 gives the teacher complete control over the timing of the presentation. If the teacher prefers to have a 10-second time delay before automatically continuing, the instruction DELAY 10 would be used.

The FIND 426 command tells the player to search for frame #426, which contains the logo for the *Voyager* mission. The text following the < is ignored. This comment field is used to remind the teacher of what is happening and is completely optional.

AUDIO 1 tells the videodisc player to turn off audio channel #2 and only use audio channel #1. The staus of the audio settings is indicated at the upper right corner of the monitor. AUDIO 0 means that both channels are turned off, while AUDIO 3 means stereo.

The PLAY 10071 TO 14095 command instructs the player to search for frame #10071 and play at normal speed until it reaches frame #14095. The beginning and end frames of this film sequence are indicated under BEGIN and END on the monitor. CURRENT indicates the frame being displayed at the moment. Normal play is indicated by FWD 30 (30 frames per second in the forward direction).

While the film sequence is being played, the teacher can stop the player by simply pressing the space bar. This allows the interjection of special comments. Pressing the space bar again continues play. However, the teacher can abort the rest of the sequence by typing A, or take control with the keyboard by typing K. This allows the teacher complete flexibility in adapting to the particular circumstances in the classroom.

Commands 5 through 8 turn the player into a slide projector beginning with frame #427. The first JUMP command tells the player to advance one frame six times before going on to the next command. Since the delay parameter has been set to zero, each new frame will only be shown when a key is pressed.

Other easily remembered commands allow the teacher to play slow motion either forward or backward, to blank the screen on still frames to avoid distracting the students, to turn control of the player over to the remote control unit, or to return control to any command in the file.

The program has provisions for processing commands as they are typed into the computer and/or storing them for later use. A built-in line editor allows the command files to be corrected and/or customized for special uses.

The current version of the program is written in PASCAL and is designed for use with a Pioneer 7820 model 3 videodisc player controlled by an Apple II computer through an Allen interface. It can easily be adapted for use with a different player and/or interface, but converting it to another computer would be more difficult since the display is written in graphics mode.

VIDEODISC SIMULATIONS FOR TEACHING CLASSROOM DISCIPLINE: CRITICAL INCIDENTS IN DISCIPLINE

Alan D. Evans, Gene R. Cupp, and William D. Milheim

Introduction

There is a small but growing body of research about interactive video that indicates it is an effective medium. A number of studies have focused on the use of interactive video to simulate interpersonal interactions. For example, Schroeder (undated) found that Videodisc Interpersonal Skills Training and Assessment (VISTA) was more effective than role playing and programmed text in teaching leadership and counseling principles. Also, Hupp (1984) found interactive video more effective than traditional behavior modeling classroom training. Interactive video training required less time, and a higher percentage of interactive video participants used the target behaviors effectively. Because of these successful applications, interactive video might be an effective tool in preparing classroom teachers and in continuing inservice training.

Classroom Discipline

No concern is greater for both experienced and beginning teachers than that of a serious discipline confrontation where immediate action is required which, if not appropriate, could result in a crisis situation. In the past, teachers were expected to maintain control in the classroom by using authority invested in their position. Student behavior was controlled through grades, retention, humiliation, corporal punishment, suspension, and expulsion. In more recent years, classroom authority and classroom control have been subjected to a number of intervening variables. Increased attention to issues such as civil liberties, the right to dissent, due process, right to privacy, and child battery and abuse have reduced the appropriateness and effectiveness of traditional authoritarian classroom control.

Teachers need to develop new habits for managing students based on principles of fairness, respect, and student participation. The most difficult times to apply these principles are during confrontation or during potential crisis situations that threaten teacher control. Therefore, teachers need multiple opportunities to practice dealing with conflict.

Preparation to meet the challenges of critical discipline situations in teaching has been limited to reading, discussions, simulations on film/video, and interactively on computer via a videotex presentation. The effectiveness of all these modes is limited by several factors: (1) the materials are abstract or simulations are in a passive observer format; (2) there is time to analyze the incident that is not usually true in the real life situations; (3) feedback to the response is academic rather than interactive; and (4) consequence remediation is missing.

Interactive Video Simulation

Interactive videodisc technology has the capability to overcome most of the above limitations. The tremendous power of interactive videodisc is that it can simulate life very realistically with high quality video and can force the teacher to choose a course of action. The consequences of that choice are then realistically presented on the screen with the possibility of confronting the teacher with yet another decision.

The development of an interactive video program designed to present teachers with simulated classroom confrontations, require an action, and present the consequence of that action is described in this article. Although the program can be used by individual teachers, it is designed to stimulate a group of teachers to

discuss alternative actions and arrive at decisions consistent with their philosophical beliefs about dealing with students..

Production Schedule

Planning

February, 1986. The macro design for the interactive videodisc was produced by the principal and co-investigators. This design defined the types of scenarios, the "personality" of the disc, and the records to be collected concerning teacher interaction.

Development

March-May, 1986. Students in the graduate class, C&I 6/77433, formed design groups that teamed with a consultant and the investigators to flowchart and storyboard the scenarios. These groups then produced a rough-cut videotape, programmed the computer, and conducted a formative evaluation using the interactive videotape with classroom teachers.

Production

June, 1986. The instructional designer, employed in the College of Education at Kent State, programmed the computer and directed video recording for mastering on videodisc. A special section of the Kent State for Kids summer program titled, "Acting for Television," provided student actors for the production.

Implementation

September-December, 1986 (with continuing availability of materials). The principal investigator and co-investigator are implementing the program using cooperative teachers who work with Kent State and Hiram College. Inservice workshops will be conducted to advise school systems. Additionally, the materials will be used with graduate supervision and administration classes.

Equipment/Software

Pioneer LD 4000 videodisc player
Apple IIe microcomputer
Allen VMI interface
Superpilot Authoring Language

Collaboration

Personnel at Kent State University and Hiram College collaborated in this project because the needs and experiences of the large state university and the small private college will guide the development and implementation process. Because Kent State and Hiram College are distinctively different institutions, there are different approaches and procedures used in working with public schools. The impact will also be greater because each institution works with different schools systems. The experience gained at multiple settings should provide information that will make this and subsequent interactive videodisc instruction useful in schools across the state.

WVIZ-TV, a Cleveland PBS station that provides videodisc equipment to schools, is cooperating by circulating the disc to northeast Ohio schools. A copy of the disc will also be circulated by Kent State University's Audio-Visual Services (which operates a large rental film collection).

Budget

Partial funding ($6,370.00) for this interactive video project was provided by the Martha Holden Jennings Foundation, Cleveland, Ohio. Although an interactive video project of this magnitude might ordinarily cost $50,000, real cash expenses were minimized in the following ways: (1) the discipline scenarios were designed by graduate students in an interactive video class, (2) student acting was donated by students enrolled in a special Kent State for Kids summer workshop titled, "Acting for Television," and (3) Kent State's Teleproduction Services donated videotaping and editing services in a cooperative effort to produce Kent State's first videodisc.

Evaluation

Through an evaluation of the project, teacher perceptions of and satisfactions with the program and changes in confidence levels concerning classroom discipline will be collected. Additionally, the Superpilot management capabilities will log all student responses, allowing a comparison of responses from beginning and experienced teachers. This log will also guide the development of future interactive video programs.

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TEACHING EMPLOYMENT INTERVIEW SKILLS THROUGH INTERACTIVE VIDEO INSTRUCTION

Gary Shulman, Robert Vogel, Susan Reilly, and
Leonard J. Simutis

Introduction

Many educators subscribe to the adage often attributed to Confuscious, "I hear and I forget. I see and I remember. I do and I understand." Indeed, it is generally believed that students retain about one-fourth of what they hear, one-half of what they see and hear, and about three-quarters of what they see, hear, and do. Interactive video programs can actively encourage the student to keep seeing, hearing, and doing. Retention is improved by leading the student through many problem-solving situations and decision points. While the potential of this technology has been well documented, actual examples of its use in the social sciences at the higher education level are relatively difficult to find. The general purpose of this article is to describe the application of interactive video technology to the teaching of employment interview skills in colleges and universities. To this end, production and education issues related to this project will be discussed.

Production Issues

Similar to any training effort, the production of the interactive video programs began with the identification of the target students, a needs assessment, concept development, learning objectives, and content outline. A workable script was devised with the help of a computer expert who was familiar with interactive authoring languages and a learning expert capable of transforming the topic concept into a lesson plan. Through the interview process a structured, linear, sequential program experience for the student seemed to be suggested. The video script and computer programs were based on a flowchart that included such things as the video scenes, computer menus, decision points, branches, and loops. Yet the underlying programming and instructional design sequences captured in the videodisc depended on complex, non-sequential, and non-repetitive approaches.

Team Concept

As in the case of similar projects in computer and video-based instruction, the development of collaborative working relationships among subject matter specialists, instructional designers, computer specialists, and video professionals is an essential element for a successful project. The collaboration is even more crucial in videodisc projects, and the difficulty of finding common ground is more problematic, since interactive videodisc presentations depend on nonlinear, non-repetitive techniques.

These elements became most evident in the latter stages of project execution. Even with a well-designed authoring language, dedicated and talented computer programmers, and a persistent instructional designer, a very large number of error-filled video and text fragments had to be corrected. This discovery and correction process typically involved at least two and usually more team members. Errors included inaccurate video addresses, typographical errors on text screens, inappropriate or illegal branching by the program, abrupt transitions between scenes, and lapses in program logic. Since these problems cannot be identified until each of the components--subject matter, script, video, and authoring--are assembled and tested, inadequate project sceduling for error detection and correction can cause

missed deadlines. Beyond correcting the obvious logical and typographical errors, once the product is seen as a whole, individual elements, such as continuity in screen design for text location and consistency in language and syntax, will require careful and detailed work to assure a smooth, functional interactive environment. While 90 percent of project time initially appeared to be devoted to a script, video, and authoring, in reality, at least 40 percent of project time was spent on the final 10 percent of the project overcoming programming problems and assuring logical breaks in the instructional design and visual and textual continuity.

Based upon initial consultations with interactive designers/trainers affiliated with AT&T Communications, General Electric, NCR, and Procter & Gamble, an initial five-member team concept was employed: project director, instructional designer, content designer, computer programming coordinator, and video producer/director. The complexity of the project required the adding of specialists in computer screen design/editing and scoring/evaluation. Universities, by using campus personnel and students for parts of the job, could produce teaching discs at a reasonable cost. There were many professionals on campus who contributed the requisite resources. Collegiality created the proper team climate necessary to complete a successful project. For example, while six principal people were involved on an on-going basis, before the project was completed 24 other people, representing 15 different campus units, became directly involved.

Project Director

Although the interactive video process requires a team effort, at least one person must have a clear vision of what the final product will look like. That person should coordinate the project and follow-through on the entire process. The project director's biggest challenge was coordinating the communication among team members. Only through good team communication could the project succeed. Even within the main project team, overcoming the "Tower of Babel" effect and finding a common language was difficult. For example, the term "evaluation" initially held a significantly different meaning for each of the team members. In addition, another related communication challenge was to find a common time for team members from different units to meet. Although the project manager served on a part-time basis, he was able to focus on the day-to-day situations effectively because he was relieved of direct supervision of daily budgetary concerns by a senior university administrator.

Content/Instructional Design

The Screening Interview was designed to help prepare college and university students for on-campus employment interviews with corporate recruiters. Within the context of the simulated interview situation, students functioned as the alter ego of either the candidate or the recruiter reviewing and evaluating five stages of the interview process. The program focused on appropriate verbal and nonverbal behavior and provided a rating profile of the student's interviewing skills. The rating profile guided students to areas where additional study or preparation were recommended.

The simulations used the same videodisc but experiences were customized through the use of different computer programs that were on floppy disks. The floppy disks controlled the access points on the videodisc and text screens that appeared during the simulation. For the recruiter, the simulation was built around the following five interview stages: breaking the ice, asking questions and verifying information, answering questions and promoting the company, closing the interview, and decision making. The simulation was designed to increase competency in areas such as phrasing questions, processing information, probing for additional information, answering questions, and applying equal employment opportunity guidelines.

For the candidate, the simultation was built around the following five interview

stages: breaking the ice, answering questions, asking questions, closing the interview, and decision making (by participating in this stage which was a required activity of the recruiter, the student gained an empathic understanding that helped him or her in the role of interviewee).

The student had two options within each version as to how he or she wished to process the simulation. The "Minimum Feedback" format took about 25 minutes to complete the first four interview stages and was recommended to the experienced or advanced student. It involved viewing a scene and responding to prompts. The program automatically took the student to the next scene and prompt without a full critique or rationale. At the end of the complete simulation (first four stages), the student received an overall score and a performance profile.

The "Continuous Critique" format took about 45 minutes to complete the first four interview stages and was recommended for the student with minimal interviewing knowledge/experience. Immediately after student responses, a verbal feedback/ rationale, together with a video scene demonstrating a satisfactory response, was shown if needed.

In the fifth stage, decision making, the student had the opportunity to evaluate the candidate (from the recruiter's perspective), using the accompanying evaluation form and observation notation form. A description of the company, job description and requirements, and candidate resume data were included with the simulation package. Upon completion of this stage, the correct entries for the evaluation form were displayed on the screen. The student then self-scored the evaluation.

Visual Design

The best idea and most carefully worked-out plan for a videodisc can be undone in no time if the visual presentation on the disc is not thoughtfully executed. Therefore, a careful plan was made for the design of the two components of the visual presentation: the videotaped action and the electronic text frames. These two components had to be visually compatible because viewers moved back and forth from video to text and sometimes would look at both simultaneously. The colors chosen for each component were complementary. The people and objects in the videotape were arranged so there would be room in the picture for the clear overlay of text when needed. Also, careful attention was given to make sure information in the text referred correctly to information in the video. The names and positions of people were identified properly, and the appropriate tense was used when the viewer was asked to consider an event he or she had just seen or one that would occur in the future.

Writing evaluative/feedback text to be read from a CRT screen presented special challenges. The following measures were used and found to successfully aid clarity and readability. The length of each line of text was kept to 40 spaces. Each paragraph contained one or two sentences. In each sentence, an attempt was made to convey just one idea as simply and directly as possible. Short paragraphs made the frames easier to read. Three or four lines were allotted to the paragraphs in order to allow for more space to be incorporated into the frames. Sentence stucture was kept simple. Action verbs were used whenever possible instead of adjectives and adverbs. Double spaces were used between paragraphs. All text was left justified with a ragged right edge. Upper and lower case letters were used to increase readability.

Some advertising layouts worked well as aids to organize information on a computer screen; grids were also helpful. A picture window layout, consisting of a white window centered on a black background, was chosen for the text frames for the *Screening Interview*. The window frame added balance and unity to the text presentation and pushed the text out toward the viewer. The color of the border of the window changed, corresponding to the color of the touch screen panel pushed by the students as they entered a decision/ reaction regarding the interviewer or interviewee's behavior. The colors of the

touch panels were chosen because of anticipated stereotyped/ergonomic responses to them. For example, blue was used for satisfactory, red for needs improvement, green for probe for additional information, and yellow for no probe. Highlighting, in the color of the window frame, was used to emphasize significant words in the text frames.

Students were more comfortable working with information that was aesthetically pleasing. To maximize student interaction and minimize computer phobia, touch screen technology was used. At all decision points the student had the option to exit the system. It was found that the pressure of the evaluative messages were lessened to some extent by making the visual presentation comfortable, readable, and clear for the student.

Education Issues

The impetus of the program came from the realization that students often find it difficult to see the application of theory (situational variables, verbal and nonverbal variables, roles, perception, and feedback) to communication skill development in an applied context such as interviewing. The use of interactive video systems for teaching interviewing skills allows for the immedicate visualization and application of theories to a realistic situation. Interviewing is especially well-suited for application to a self-paced interactive technology because it is visually oriented and allows the student to see the theory in action.

The content area is also appropriate because the material will be held constant over a long period of time and administered to many people on an irregular schedule. The disc does not wear out and can be used virtually indefinitely. Minor modifications can be made inexpensively by computer reprogramming, although the disc itself cannot be changed. In addition, students can come to a career planning office or classroom at a time that is personally meaningful (typically before participating in actual interviews).

This high degree of student involvement, combined with the ability of the program to adjust to the student by skipping material that is already known or reviewing segments that are more difficult to understand, often enhances and accelerates learning. This sense of freedom and control heightens student interest and attitudes toward the content of the program.

The necessity to bring groups of students to a central location for instruction is eliminated through interactive programs. Allowance is made for individualization of student needs in the programs, while still insuring a "standardized" presentation at multiple locations and different times.

This method is particularly useful for institutions where many students are trained at different campuses in a short, efficient time interval. Once a disc is mastered, it is relatively inexpensive to reproduce copies. Amortizing the fixed costs over many discs reduces the overall cost per student. The technology is, therefore, less appropriate for applications that have small numbers of students, or for material that must be updated in a short time interval.

The program can be used as an adjunct to other teaching methods. Beyond training, students are allowed to be involved in simulated testing or diagnosis through interactive video. The simulations can be perceived as vivid and extended case studies that can be used for training, diagnosis, and evaluation.

Evaluation

Pilot testing of the program by students focused on affective and cognitive evaluative dimensions. Student reactions yielded positive feelings and attitudes toward the program experience. Because interactive videodisc systems are new, field testing focused on both an introduction to the technology as well as an assessment of the usefulness of the videodic for training interviewers and interviewees. It was often difficult to distinguish satisfaction with the program from curiosity about the technology

itself. Since interactive videodisc is one of the "window" technologies--those who see it for the first time inevitably think of dozens of applications for their own particular area of interest and experience--it is possible that field testing may be confounded by questions about how the technology works, rather than if or why it works in the particular application being tested. Nevertheless, preliminary findings on the cognitive dimension supported the effectiveness in promoting learning for the content portion of the program. Student scores did vary positively with their pre-program experience and improved as time spent with the program increased.

Summary

The production issues and educational issues encountered in the creation of an interactive video for the human communication field were discussed in this article. Key production issues included the team concept, project director role, content/instructional design, and visual design. Conceptual and pedagogical advantages of blending interview content with the technology and an evaluation of the effort were discussed as educational issues. In conclusion, interactive video is now affordable and applicable for a variety of training situations. Application opportunities for this new technology are limitless. It is the learning method of choice when learner control, branching, computer control, and rapid random access are desirable.

TEACHING BIOLOGY WITH VIDEODISCS AND COMPUTER GRAPHICS USING AN ELECTRONIC BLACKBOARD

Michael A. Kolitsky

Introduction

The increasing availability of database videodiscs in the life sciences as well as many other disciplines, coupled with the appearance of video-projection monitors capable of producing bright, clear images of large size on flat projection screens, laid the foundation for testing the concept that the chalkboard, overhead projector, and slide projector may be replaced by an electronic blackboard system in the classroom. A consortium of electronic components was assembled into a functional electronic blackboard system, consisting of a Pioneer videodisc player (Model LD-V4000), an Apple IIe microcomputer, a VAI// interface (Videovision), and a Sony color video-projection monitor (Model 2020Q) capable of producing a viewing area of 140 square feet. This sytem was used in a 250-seat lecture hall, and the displayed image could be clearly seen from any vantage point in the room. The VAI// interface responded to computer commands and served as the signal switching device so that high quality images from the Biosci or Life Cycles videodiscs (Videodiscovery) or graphics from a floppy disk source could be displayed by the video-projection monitor. The electronic blackboard was utilized as the sole source of visual imagery in three university-level biology courses during the 1985-1986 academic year. A one-semester elementary biochemistry course and a full-year course in anatomy and physiology were taught using the electronic blackboard. During the fall semester of 1986, the electronic blackboard was used for the first time in a vertebrate embryology course and in a repeat of the anatomy and physiology course. In future semesters, an opportunity will be provided to utilize the electronic blackboard for the first time in a cell biology course and in the second half of the anatomy and physiology course at California Lutheran University.

The assemblage of electronic components used at the California Lutheran University exhibited a true consortium flavor, in that at least five companies were represented in the final functional electronic blackboard. Pioneer produced the videodisc player; Videodiscovery provided the Biosci or Life Cycles videodiscs; and the video-projection monitor was made by Sony. Videovision produced the interface and Apple provided the controlling microcomputer. The system was assembled during the month of April, 1985. The cost for the components was approximately $8000.00. A search in the projection television industry showed costs for color projection monitors ranged from $5000.00 to $100,000.00 and indicated that if electronic blackboard systems were going to be widely used in education, the purchase of this key component could provide a financial stumbling block for many school budgets. Efforts to raise the necessary funds included grant requests to foundations and community support groups, as well as efforts to compete for in-house support from the university budget and from department resources. Approximately $5500.00 was obtained from foundation and community support groups, and the university and department budget absorbed the remaining costs. Costs for setting up such a system on other campuses will vary, of course, because many institutions have Apple computers and a growing number have video-projection monitors as well.

How the System Works

The inclusion of an Apple IIe micro-computer as the controlling element for displaying either videodisc images or computer graphics places this form of electronic blackboarding at a level III degree of inter-activity. Certain software needs must be

satisfied when using this system. The operating system must be PRODOS rather than DOS for several reasons. The most important reason is that the supporting software which accompanies the VAI// interface utilizes PRODOS. The VAI// program is written in Applesoft BASIC and designed so teachers may incorporate their own programs into it in order to control the display of either videodisc images or computer graphics onto a single monitor screen. Another reason for using PRODOS is that Mousepaint, an Apple-produced drawing program, also utilizes PRODOS. Mousepaint has been employed as the primary method for producing the more complicated graphics screens needed when the videodisc lacks an appropriate image. Mousepaint employs a "mouse" which connects to an Apple expansion slot rather than the game port. This is important because the VAI// interface is constructed to use the gameport. If one wishes to have the electronic blackboard available as a drawing or writing screen in class using the "mouse," it is necessary to use a drawing program and hardware system that connects to the Apple via an expansion slot. The last advantage of PRODOS is that it loads graphics from floppy disks to the Apple IIe high resolution graphics screen about three times faster than DOS. Actual time is approximately three seconds, which helps to expedite the transition from one screen to another screen during lecture presentations.

Two programs have been written to accompany the VAI// software; these programs enable the instructor to prepare a series of screens to enrich the lecture experience. The instructor may choose from three screen options. A text screen, graphics screen, or videodisc image may be chosen for inclusion in a lecture and placed in the desired order for presentation. All text is written onto the second high resolution graphics screen of the Apple IIe from character sets stored as shape tables in the Apple memory. Any desired character or shape need only to be included in the character set in order for it to be available for use on the electronic blackboard screen. The first program was called *Graphic Generator* ; in order to exploit the potential of this program fully, some knowledge of Applesoft BASIC is needed. Because PRODOS is the operating system, *Graphic Generator* will only work in Apples with a minimum of 64K memory. The second program was called *Screen Generator* and was designed to be user friendly. No prior knowledge of programming is needed to employ *Screen Generator*. It was written to utilize the extended 80 column card in the Apple IIe as a temporary storage buffer for files and requires 128K of memory. *Graphic Generator* was utilized in the author's courses last year. During this year, *Screen Generator* will be used in the author's classes to field test it and find out where improvement is needed.

Implementation

Many strategies are employed by academic computing directors and school administrators to encourage faculty members to develop computer skills and incorporate videodisc technology into the classroom setting. Electronic blackboarding appears to be a promising way this can be done. Last June, the author served as the instructor for three colleagues who chose to learn electronic blackboarding as their project in a workshop held for faculty members. A chemist, geologist, and a philosopher with an interest in bioethics utilized *Graphic Generator* and *Screen Generator* in their courses during the past year. Another important benefit of training teachers in the art of electronic blackboarding is that it permits teachers to focus upon their teaching styles and pedagogies at the same time they are learning how to incorporate vidoedisc technology into their classroom presentation. This combintion of outcomes not only enhances teaching skills but also reinvigorates the teachers; they now discover they can do things in the classroom that were not possible before. On this basis, the electronic blackboard should be viewed as a type of research tool which, in the hands of skilled teachers, will permit them to explore and implement new ways to teach.

There are a number of other advantages to be gained by teaching with an electronic blackboard. It serves as a highly effective way to enrich the lecture experience with high quality images from videodiscs. Videodiscs are now available for teaching in many

disciplines, and electronic blackboard systems are an ideal way to display such information. Computer control of image access from videodiscs enables the teacher to program the sequence of images to be displayed in class prior to the lecture. In this way, new images may be displayed by simply pressing any key on the computer keyboard, thereby permitting the teacher to concentrate more fully on the lecture presentation. Electronic blackboarding is also a cost-effective way to use a single videodisc to teach a large number of students.

Computer graphics designed by the instructor were utilized whenever images unavailable on the videodiscs were required in the course or whenever text information was desired. Computer simulations of experiments were also employed using the electronic blackboard to increase the degree of student-teacher interactivity and to promote the attainment of problem-solving skills. Hard copies of all graphics used in a lecture were given to the students prior to the lecture to assist them in taking notes. An interesting outcome emerged from the practice of giving students copies of the screen graphics. When examining student evaluations, it was found that a large number of students felt they were learning better because they could now listen more closely to the lecture. Students also mentioned in their evaluations that there were many other courses in addition to biology which would benefit from the utilization of the electronic blackboard; the students pointed to the potential usefulness of electronic blackboard across the curriculum.

Looking to the Future

The experience of teaching several courses with an electronic blackboard prompts some suggestions about future videodisc design.

1. Begin to focus on visual material to support a single course by working with book publishers to produce videodiscs to accompany course textbooks. Any picture, diagram, or table appearing in a textbook should be placed on a videodisc in order to be displayed in class during the lecture.

2. Include more simulations of experiments designed to promote better understanding of course concepts and the scientific method.

3. In addition to high quality images of actual material, include labeled computer graphics of the same material maximizing the use of color and diagrammatic simplicity for ease of student comprehension.

4. Provide a master manual with the videodiscs that contains digitized copies of all images of actual material and graphics so the teacher may duplicate them for student use during the lecture.

Progress in electronic blackboarding is dependent upon videodisc production and design. Videodisc availability, how they are designed, and the information they contain will control the pedagogical strategies possible with electronic blackboarding. It is a new way to teach and could serve as the needed force to revitalize and rethink how teachers teach and students learn.

'ACID, BASES, AND YOU': A PROTOTYPE INTERACTIVE VIDEODISC SYSTEM FOR HIGH SCHOOL CHEMISTRY

Ronald C. Laugen

Introduction

In 1984, a project was funded by the Palm Beach County, Florida Schools, with support from the Florida Governor's Office, to design, develop, and evaluate a prototype micro-computer-controlled interactive videodisc (MCIV) system at Florida State University for high school science instruction. *"Acids, Bases, and You"* was the result of this pioneering project.

Development

In consultation with the project advisory committee, the development team selected the topic of acid-base chemistry, which would be taught in the second semester when the field test was conducted. The team also identified required county knowledge and skill objectives related to acid-base titration and planned a focus on the practical applications of chemistry.

Aided by the advisory committee and chemistry faculty at Florida State, a series of four lessons, an optional puzzle, and a unit test that explored the potential of the MCIV medium were created by the team. The lessons, which took about five hours to complete, contained interactive problems, tutorials, demonstrations, and simulated experiments to be used by individual students.

The IBM PC, the principal computer in the Palm Beach Schools, was used in the prototype delivery system. A Pioneer LD-V6000 disc player, an infra-red touch-screen monitor, and a custom switch completed the system. Three of these systems were installed at the field-test site in March, 1985.

Field Test Results

The extent to which students learned the content without the help of a teacher or a text was assessed in the field test. Student and teacher attitudes toward use of MCIV instruction were also measured.

Students performed quite well on the posttest; the adjusted pre-post mean test score increased from a raw score of 12 to 25. Seventy-five percent or more of the students performed satisfactorily on eight of the fourteen lesson objectives. The field test instructor was pleased with the test results, especially for some previously unmotivated students.

A sample of the field-test students was also asked to work in the laboratory. All were able to read liquid levels in a buret and perform titrations to the proper endpoint agreement. Their only prior experience had been with the MCIV simulations.

The attitudes of the chemistry students and the teachers using MCIV were strongly positive. The system and lessons were easy to use, and students enjoyed working at their own pace and interacting with the system.

Conclusions

From the experience of involved staff members in Palm Beach County, the following conclusions were reached:

1. MCIV should be located in the classroom and should be an instructional resource along with the teacher, the text, and the laboratory.

2. Students benefit from working in pairs and small groups on an MCIV system.

3. The focus of the videodisc content should be an experiment simulation, which can be done either by the teacher, by small groups, or by individual students.

Issues in MCIV Science Instructional Development

1. To what extent can costs be reduced by the use of existing video, slides, and film? How would use fees be calculated and paid?

2. What is the proper role of the public sector (NSF, states, school districts, foundations) in funding development? What should be the involvement of the private sector (computer manufacturers, publishers)?

3. Should the role of MCIV technology be viewed as evolutionary or revolutionary? Can technology change schools? Should such change be attempted?

RESULTS OF IMPLEMENTING AND EVALUATING CLASSROOM APPLICATIONS OF AN INTERACTIVE VIDEODISC HIGH SCHOOL SCIENCE PROJECT

Dorothy Jo Stevens

Introduction

The results and implications of a project recently completed at the University of Nebraska (UNL) that focused on the instructional applications of interactive videodisc (IVD) high school science lessons are discussed in this article. Instead of presenting the findings in the usual structured format, the procedures and results are summarized and more emphases placed on describing the behaviors, achievement, and attitudes of teachers and students in the different learning environments. Most educators, at this point, are more interested in some of the problems, concerns, and successes found in using these lessons to teach science rather than in a detailed statistical report of the study. A more formal report of the study may be found in an article in *The Journal of Computers in Mathematics and Science Teaching*.

Furthermore, an assumption was made that the reader will be aware of videodisc technology and the interactive capabilities created by interfacing the computer with the videodisc. If this is not the case, it may be necessary for the reader to become acquainted with the general aspects of IVD technology in order to understand the hardware configuration and some of the instructional application concerns.

Brief Description of the Instructional IVD Project

The project was funded by the U.S. Department of Education to modify existing college science videodiscs to meet the learning needs of high school students. Four science lessons and the appropriate printed support materials for students and teachers resulted from the project. The four science lessons included two in chemistry (Titration and Chemical Unknowns) and two in biology (Respiration and Climate and Life). A brief description of each lesson and the hardware required is presented later in the article. The main objectives of field tests were to explore different instructional approaches or alternatives to teach science in classroom settings that utilized the IVD materials, to observe student and teacher behaviors, and to evaluate the instructional design of the software. First, however, it is important to understand the rationale for focusing this project on classroom instructional applications.

Research Findings

The basic premise of the project was that IVD instruction is as good as, if not better than, other forms of instruction. The effectiveness of using IVD as a teaching or training medium has been supported by numerous researchers (Allard & Thorkildsen, 1981; Bosco, 1986; Henderson, 1983; Hofmeister, 1982). Gibbons (1982) went a step farther and included decreased learning time as part of the overall effectiveness. The decision was made not to compare IVD instruction with other types of instruction but to attempt to find practical and realistic methods suitable for most teachers of high school science students. A second assumption was that no one specific application would be used in all field sites but that teachers in each of the settings would determine the application procedure they believed would fit their instructional environments. A myriad of problems was created by this decision; many researchers thrive on clean designs and the ability to generalize. Where possible, statistical analyses were conducted; in other settings descriptive forms of information were gathered.

Field Sites, Hardware, and Lesson Descriptions

Field Sites

The revised IVD science lessons were field tested in five different settings in two states: two urban high schools (Schools A and B), one parochial school (School C), one rural school (School D), and mathematics and teacher education students at UNL (MS/TE).

In almost all cases field tests were either replicated or modifications made based on previous data. Materials were refined accordingly. Thus, information was gathered from two periods of usage in each of the five different sites, resulting in ten instructional episodes. The usual types of instructional constraints existed. Only one or two IVD systems were available for 25 to 30 students; class periods were generally 45 to 50 minutes; curriculum objectives were often tight and rigid; and teacher personalities and teaching styles differed.

Hardware Requirements

The Level 3 IVD system configuration consisted of a Pioneer LV-D 6000 videodisc player, color monitor, 128K Apple IIe microcomputer system with two disk drives, a super serial card, and a paddle controller. The need to synchronize the motion sequences with the computer program required a more sophisticated type of videodisc player (Level 3), and the need to view color changes required a colored monitor. Computer-generated text was displayed on the Apple IIe monitor. In the two-screen configuration, students would view the visuals on the colored monitor and read the text from the computer monitor. Therefore, there was a need to place the monitors as close together as possible to facilitate learning. An overlay, which allowed text and visuals to be displayed on one screen, was the original hardware set-up. To eliminate screen clutter and make the system as cost effective as possible by using equipment already in the schools, two screens instead of one were used.

Description of Science Lessons

All science lessons were menu driven to allow learners of different abilities to control the pace and paths of learning. All lessons were interactive, which required extensive user participation. Each lesson was accompanied by student and teacher support materials (directions, worksheets, tests, sample lesson plans, etc.). Students had the option to repeat, recheck, practice, and enter or exit at almost any point in the lessons. Feedback was given based on answers, and guidance was provided when necessary. The non-linear capability of the equipment was maximized by the instructional designers as much as possible.

Chemical Unknowns . This lesson is a simulation that uses the discovery approach. Students collect their own data by viewing the reactions caused by mixing two chemicals. For example, when silver and barium are combined, students see that the chemical reaction is a white precipitate. Once the students feel they have enough information, they test their data by trying to identify an unknown solution. After entering their answers, students know immediately whether they are right or wrong. Students soon find out the data collected must be sufficient, organized, and accurate. Various levels of difficulty are provided. Unknown solutions are randomly generated to eliminate repetition.

Titration. This lesson simulates the titration experiment usually conducted in the laboratory. Students determine the concentration of a solution by measuring the amount of a solution of known concentration required to neutralize the solution of unknown concentration. The lesson is divided into six sections and allows students to conduct the titration procedure from beginning to end. For example, students simulate the preparation procedure (wash, rinse, fill the buret, etc.), select and weigh the sample, make titrant decisions, conduct the titration, and finally calculate the concentration based on their data. By using the paddle controller, students are able to control the flow of titrant to reach the point of neutralization. Calculations are entered and evaluated by the computer with a side-

by-side comparison of each entry to allow students to see exactly where mistakes were made.

Respirations. This lesson simulates the effects of temperature on the respiration of a frog, a mouse, and a test tube of peas. Students vary the temperature to study the effects on the organisms. This lesson is an excellent example of how interactive videodiscs can provide a set of experiences that would be too difficult, dangerous, or unacceptable for students to actually perform.

Climate and Life. A visual component is given by the videodisc to illustrate the criteria necessary for certain plants and animals to exist in the various biomes of the earth. Students interactions are evaluated to check levels of understanding. One feature of the IVD biome lesson is the inclusion of a biome map that is not generally found in high school biology curriculums.

Instructional Approaches and Deployment of Equipment

In each field site, slightly different approaches were used. However, the instructional strategies reported seemed to fall into two broad categories: (1) the learning alternative or supplementary approach, where the IVD systems were placed outside the classroom in an adjacent room or the media center; and (2) the classroom integration approach, where the IVD systems were placed within the classroom and the lessons integrated into the classroom instructional process.

IVD as a Learning Alternative

The alterantive approach was used by Schools A, B, and C, and mathematics and science teacher education students at the University of Nebraska (UNL). In School A and UNL, the systems were placed in an adjacent room; in Schools B and C, the systems were placed in the media center.

Each science teacher used the science lessons differently for numerous reasons. For example, in one setting the students had just completed titration, and the IVD materials were used to reinforce concepts learned. Teacher directions or expectations of students using the IVD materials ranged from "if you want to" to "it is required." The number of students working at a system at one time varied from one to seven. In almost all instances, groups remained on-task. One observed exception, however, was a group of two girls who hit any key just to fulfill the requirements. These girls were described by their instructor as good students from an accelerated chemistry class; they were extremely grade conscious and resented the time taken away from any graded assignments. It was also obvious these girls were extremely loyal to the instructor. It was observed that students who were given specific assignments and some sort of grading expectation were much more responsive to the experience.

In Schools B and C students were sent to use the system in the media center. Student responses were similar to those mentioned above. However, this was the only place where a hardware problem occurred. The IVD system at School B, which had been working well suddenly stopped. It took several long-distance telephone calls to find out some student had, for some unknown reason, placed the interface card in the wrong slot.

At UNL, where the videodiscs were tested with mathematics and science teacher education students; reactions were extremely varied. The students either loved or hated the IVD materials. Students hating the IVD science materials appeared to have decided how they were going to teach and it certainly was not with technology. One student stated, "I want to tell them not to have a machine do it." After discussions in methods courses, however, several students changed their views, which resulted in some rather creative lesson plans.

In each site, the project was repeated the following semester. Teachers were much more creative, and had guidelines and higher expectations for their students the second time. Materials were kept at each site for a sufficient amount of time to afford the teachers ample opportunities to try them, experiment with the equipment, and develop their own ideas about how the videodiscs would be used in their classes. Teachers became more familiar with

the material and were able to strengthen and individualize assignments. Some teachers used the materials as an advanced organizer; others used it for reinforcement; and still others used the material as enrichment. One teacher used the chemistry materials solely for students to learn content and checked them out with one laboratory experiment or quiz. Success of the project can be measured in pragmatic terms; most of the teachers stated they wanted to purchase the materials as soon as they were available.

IVD as an In-Class Activity

At school site D, the researchers worked with the teacher to identify an appropriate instructional strategy. The instructional strategy selected was to sequence the IVD lesson with the laboratory experience during the chemistry class and place the system in the classroom. A basic question asked in this study was whether students who used the IVD to study a titration lesson first and then conducted the titration experiment in the laboratory (IVD/Lab) could learn as much and have the same attitudes about titration as students who reversed the sequence (Lab/IVD) by conducting the experiment in the laboratory first and then used the IVD lessons for reinforcement.[1]

Two systems were placed in the classroom opposite the laboratory stations. An initial lecture was given by the instructor that included introductory materials concerning acids and bases, procedures, and expectations of students.

Pre-post attitude and achievement test scores were collected. Researchers coded classroom activities and student and teacher behaviors by classroom observations and from videotapes taken during class session. A brief summary of the findings is presented.

Statistical findings. There were no significant differences in achievement or attitude scores between the IVD/Lab and Lab/IVD groups of students. The standards set by the instructor were reached in both groups. According to this study, IVD lessons and labs can be sequenced differently, thus allowing a better utilization of materials, equipment, and work stations. It would appear that the IVD science lessons worked equally well used as an advanced organizer or as reinforcement. A closer examination of the data provided additional information for science teachers to consider.

Although not significantly different, the IVD/Lab group had a higher mean achievement score ($\bar{X} = 88.4$) and was more homogeneous ($Sd = 7.8$) than the Lab/IVD group ($\bar{X} = 77.3$, $Sd = 16.0$). While this information may not seem important, it takes on new meaning when teachers try to match individual learning needs of students. Attitude scores, however, were very close and had similar standard deviations.

Instructional design evaluations. The evaluations of students reactions were very positive. According to questionnaires administered to assess clearness of directions, instructional activities, etc., received high ratings. According to these results, no refinements needed to be made to the lessons. The project was completed. Since there was a lack of money, time, and energy, perhaps the project should have remained as it was. However, an entirely different story was shown by the observational data.

In order for the reader to understand the difference between observational and written data, a few of the observed findings will be discussed. After coding student comments and watching student expressions, there was no doubt most of the students at this site were frustrated with the initial portion of the IVD science lesson. They had no problems operating the equipment; however, when faced with the content options, they had no idea what to do. For some unexplained reason, very few used the Help or the Definition sections. After they learned some of the material, the different options became clearer, thus contributing to positive evaluations.

[1] A detailed report of this study is published in *The Journal of Computers in Mathematics and Science Teaching.*

Although written outcomes of each group of students were similar, actual classroom procedures were not. Students who were to use the IVD system first were much more accurate and efficient when setting up and conducting the lab experiment. IVD/Lab students asked fewer questions than the Lab/IVD students (12 in 40 minutes compared to 30 in 40 minutes respectively). Their IVD/Lab groups were able to set up the titration apparatus faster and without help; they used less chemicals and were more cautious when reaching the endpoint (a slight pink color occurred when the solution was neutralized). Data collected by IVD/Lab students were carefully recorded and organized.

In contrast, the Lab/IVD group made gross errors. Chemicals were wasted because students did not use them correctly or forgot to add the indicator. In every instance, students in this group titrated far beyond the endpoint. Calculations were made after the fact. The differences between the groups when actually conducting the experiment in the lab are shown in Table 1.

TABLE 1

Summary of Observed Lab Activity Differences Between Students Conducting the Experiment after the IVD Lesson and Students Conducting the Lab Experiment First

OBSERVATION	INTERACTIVE VIDEODISC	LAB
TIME	Less time for experiment. No equipment set-up needed.	Half of lab time was set-up of equipment.
EQUIPMENT	Interactive videodisc system needed.	Lab equipment and chemicals needed. Some waste of chemicals because of errors and need to start over.
QUESTIONS	Few initial questions. Questions concerned nature of titration and interpretation of results.	Many questions concerning equipment set-up, chemicals to use, sequence of steps. Questions concerning calculations and validity/ accuracy of results.
EXPERIMENTAL PROCEDURE	Few mistakes made because students were alerted to errors immediately by program. Students became confused about what chemicals they were using during experiment.	A number of initial errors caused by confusing sample and titrant, adding indicator to wrong chemical or failing to add indicator.
ACCURACY	Students became proficient in titrating and calculating answer to within 1% accuracy.	Students consistently over-titrated causing a mean error of 5%.
CALCULATIONS	Students related calculations to type of titration done because they were performed immediately after each experiment.	Students had trouble doing the calculations and knowing what to do for each type of experiment to calculate answer.

Teacher Behaviors

Teachers rarely read the manuals. In almost all cases they admitted looking at the materials first, and if they then ran into trouble they would read the manual. Great care had gone into illustrating and emphasizing the need to adjust the color on the videodisc monitor to make sure chemical reactions were the proper colors. In almost every instance, teachers had to be verbally advised of this need, or the researcher who was involved directly adjusted the color.

There was not one teacher who went completely through the materials. This is understandable because of the teachers' busy schedules and the amount of materials available. The teachers' first attempt, in most cases, was rather clumsy. The second time, as they learned what the materials were about, teachers were much more successful in terms of management and expectations.

The instructor who was involved in the reported statistical study (School D) was surprised about the teaching role change. More time was required to plan. However, once class started, groups of students worked independently, and the teacher was more of a facilitator of learning. There was time to check student learning as well as to do a little desk work. At first, this particular instructor felt guilty not being before the class "teaching." This uncomfortable feeling soon changed to one of satisfaction because of the ability to address the individual needs of students.

Teachers surveyed, on a scale of one (low) to five (high), rated the IVD materials as very effective (4.5), supplementary to laboratory experience (4.7), efficient (4.5), and cost effective (4.8). All teachers expressed time pressure and, thus, were still not as familiar with the materials as they wanted to be. There were strong indications that given the opportunity teachers would be the ones to develop those unique, innovative approaches.

Conclusions

Evaluations and research findings for the school science project showed the interactive videodisc demonstrated content accuracy, met different learning needs of students, was easy to use, and could fit into a variety of learning environments. The following recommendations are made:

1. More research on classroom applications is needed. Strong consideration should be given to the collection of observational data along with written responses of students and teachers.

2. Teacher educators, administrators, or persons involved in staff development should provide preservice and inservice teachers with appropriate staff development opportunities that give the time necessary for teachers to become familiar with IVD materials and to develop innovative classroom applications to meet the diverse learning needs of students.

3. Specific attention should be given to encourage teachers to use the facilitator of learning method of teaching, along with other teaching methods, to improve instruction.

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AN EXPERIMENT IN EDUCATION TECHNOLOGY: K-12 TEACHERS EXPLORE THE POTENTIAL OF INTERACTIVE VIDEODISCS AS A LEARNING TOOL

Eileen Boyle Young

Introduction

A 36-graduate credit-hour program in computer education for K-12 educators has been offered in the School of Education at Spalding University since 1983. Through this program, students are certified as a specialist in computerized instruction in either Kentucky or Indiana. Students may earn either the M.A. degree (at least 30 graduate credit hours) or the Ed.S. degree (at least 30 graduate credit hours beyond the M.A.) in education, with a concentration in computer education. As of August 1986, 18 M.A. degrees and 11 Ed.S. degrees had been granted.

Because the most potent new developments in technology must be included in any consideration of instructional delivery systems, the emphasis of the program at Spalding has shifted from instructional computing (the computer as the medium of instruction) to include other instructional technologies. Through this experiment, the study and use of interactive videodisc technology were integrated into the computer education program. To explore the potential of interactive videodiscs as a learning tool in K-12 schools, interactive videodisc technology was offered to graduate students in the Computers in Education Program at Spalding University in the fall of 1986 for the first time.

The Spalding University Experiment

Through interactive videodisc technology, a learning environment is created that synthesizes the instructional capabilities of both educational television and computer-assisted instruction while limiting the disadvantages of both; it is the best of both worlds. In the Computers in Education Program, staff members at Spalding University wanted their students to do more than read what is written about interactive videodiscs; staff members wanted them to work with this instructional technology and determine its potential.

The primary purposes of the Spalding University experiment were to introduce interactive videodisc technology to K-12 teachers as quickly and efficiently as possible, without major equipment costs, and to provide a hands-on first awareness experience within the price range of the ordinary teacher. Donated equipment, including a Pioneer 8510 laser disc player and appropriate monitor and an Allen interface card and software that allows the user to program in BASIC, Pascal, or SuperPILOT on the Apple IIe computers already in the education lab, comprised the equipment configuration for the experiment.

Quality videodiscs containing resource material for the K-12 curriculum were both available and affordable. The capabilities of interactive videodisc technology, which allow "repurposing" of videodiscs, multiple uses of a given database, and creation of effective interactive instruction, were demonstrated through this experiment. "Repurposing" adds interactivity to the videodisc by designing software that arranges frames and sequences and includes computer text and graphics to suit the instructional designer's purpose. Only CAV--continuous angular velocity discs--could be used, because the format, one frame per revolution, allowed the computer to access any frame for still or motion. (The other format used in creating videodiscs is CLV--continuous linear velocity--which has two frames in each revolution.)

For the Spalding University experiment, the *Evaluation and Design of Courseware* class was divided into design teams of four members each. Each team completed the following tasks.

1. **Preparation**
   --explored use of the equipment in level one mode with the remote control unit.
   --considered instructional design pattern choices.
   --decided to follow Gagne's nine-step algorithm for the instructional sequence.

2. **Topic Selection**
   --selected a topic to be taught from the four available videodiscs.
   The titles were: *The National Gallery of Art, The History DisQuiz, The First National Kidisc* , and *Space Archive V.*
   The groups were encouraged to use material that took advantage of the system's special capabilities: freeze frame, auto-stop, chapter search, dual channel audio, slow motion, forward and reverse, and random access.

3. **Frame Selection**
   --used the laser disc player as a level one machine with remote control to identify and record disc frames to use in presenting and controlling the learning process.

4. **Computer Text/Graphics Development**
   --created sample storyboards of computer screens designed to accompany the video and enhance and control the interactive learning process.

5. **Preparation for Flowcharting**
   --tested sequencing of selected frames and computer text and graphic screens.

6. **Flowchart**
   --developed a flowchart whose purpose was to show every aspect of the presentation (computer text or graphics, video motion or still frame, audio channels off or on).

7. **Computer Program Generation**
   --generated a computer program in BASIC, Pascal, or Super-PILOT (the group's choice) with control instructions to drive the videodisc.

8. **Evaluation**
   --ran and debugged the program. This necessitated some recycling through previous stages.
   --tested the design with a target audience. For some, this meant reevaluation of the instructional sequence.

9. **Revision**
   --planned to revise as indicated.

Equipment expenditures were avoided in this experiment; the concentration was on learning to create quality interactive instructional material. Unfortunately, this kept use of the medium at the lower end of the thinking skills continuum: drill, practice, and tutorial. Staff members recognized that use could not remain at the lower level. If it did, videodisc technology would become little more than interrupted linear programming.

As graduate students, or teachers, gain expertise and experience in the videodisc medium, they will want to produce interactive videodiscs that involve higher-level thinking skills. The positive reception of this first experience may make such advanced uses feasible in the near future at Spalding University.

VIDEODISCS IN THE NORTHWEST: EUGENE PUBLIC SCHOOLS SINCE 1980

Phil Kessinger

Introduction

In April 1980, as a social studies teacher from the Eugene Public Schools, the author had an opportunity to attend the conference of the Association for Educational Communications and Technology, held that year in Denver. Videodisc activities were presented with clarity and enthusiasm by groups from MIT, Nebraska, and Utah. From that time, the author has advocated the incorporation of videodisc curriculum and instruction into educational classes. Because of this advocacy, the author has taken a number of trips to Nebraska and held meetings with videodisc professionals in Utah and California.

Introducing Videodiscs to the Eugene Public Schools

The first discussions with Eugene educational decisions makers in the early 1980's concerning the possibilities of the videodisc were not well received; it was argued they were too new, too costly, and software was not readily available. However, in the last three years times have changed, and the school district has key administrators who understand the implications of technological change and education.

District funds have been allocated for videodisc development activities and a menu driven program has been developed, written in BASIC on the *National Gallery of Art* disc. It was written for an older Pioneer VP-1000 (Apple-Allen VMI interface). This could be considered freeware if one wants to cover the cost of duplication. One version of the *National Gallery of Art* program was done for a touch screen (TSD). Another useful videodisc program was developed, which incorporated the *Villa Alegre* Chapter Authoring Program, to study the political, economic, and cultural characteristics of a feature film, *Lonely Are the Brave* (with Kirk Douglas) in a US history course. This program works well; however, it was written for an older technology, i.e., Pioneer VP-1000.

In the past two years, some Level III activities with a Pioneer LD-V4000, Allen VMI, and Apple have been carried out in Eugene. One program under development uses *Laserworks* (an authoring utility) to create an interactive program for teacher inservice in science and videodisc technology. A DRAW disc was made of the science segment of a televised homework assistance program (*Homework Hotline*). The program works well with the exception of the quality of the DRAW disc, produced on three-fourths video, which leaves something to be desired.

In 1982, a small grant was received from the National Education Association, in consortium with the Oregon and Eugene Education Associations, to produce videodisc inservice activity for teachers. The small grant development effort was undertaken at the same time a federally funded project, called *The Vim Network*, was in progress under the administration of the American Institutes for Research in the Behavioral Sciences (Palo Alto, California). Forty-five educational institutions were networked (including electronic mail) with technical and material support. These were important steps for the development of videodisc activiities in the Eugene Public Schools.

Characteristics of the Eugene Public Schools

At the time this article was written, the Eugene School District had a student population of 17,000 students housed in 40 schools. The *Vim* project occurred in one of the middle schools, in which an older Pioneer VP-1000 is still in use. There are several

consumer level players with a range of discs in three of the four high schools. Teachers use these players primarily in English classes with film study. Art teachers use the *Creative Camera* for photography instruction, one art teacher uses the Windham Hill *Autumn* for landscape study in a painting class, and an economics teacher uses an older disc concerning the Amish to teach about traditional economy and technology. At one high school, there is an older Pioneer VP-1000 which is kept in the library with the encyclopedia disc. Recently, a Pioneer CLD-909 for Level I and III activities (Allen interface and *Laserworks*) was acquired at this high school. There is also a district teacher center in which a number of discs, such as the recent *Videodisc Music Series* or *The Ninety-Six: A Cattle Ranch in Northern Nevada* as well as an older disc, *Tacoma Narrows* and consumer discs (e.g., space discs), are housed. The teacher center houses a Pioneer VP-1000 player that is circulated for teachers to preview discs; there is also a Pioneer LD-V4000 player for development and demonstration activities at the center. If the discs purchased personally by teachers are included, teachers have access to 150 or more curriculum and instruction discs to consider.

Apple Classroom of Tomorrow

A unique development in the Eugene Public Schools has been the establishment of an Apple Classroom of Tomorrow (ACOT). This program, one of the first in the country, involves the partnership of Apple Computer and the Eugene School District to establish an infusion of computer and allied technology into the classrooms with home support. The Apple Classroom of Tomorrow is housed in one of the middle schools which contains 26 computers in the class, one for each student. Computers are also loaned to the home of the families of each student. Videodiscs are used in this program, such as the Systems Impact production *Mastering Fractions* in a Level I format. One-quarter of a million dollars have been invested in new technology and education by Apple Computer and the Eugene School District.

Technology Based Alternative School

Currently, a number of educators in the Eugene School District are establishing a technology based alternative school which is a type of continuation of ACOT. The alternative school (Da Vinci Middle School) will contain several grades to establish an integrated program featuring the best instructional technology processes possible (e.g., videodisc-microcomputer) in order to achieve the traditional goals and objectives of the school district.

Concurrent with this technology based alternative school, staff members are seeking funds to establish a research and development center (i.e., Da Vinci Center) to develop curriculum materials for instructional processes with computers, videodiscs, telecommunications, etc. Staff members feel the Da Vinci Center is a well-conceived idea; one of the greatest impediments to the introduction of new technology into education is the difficulty of designing and applying the technology is a curriculum known well by teachers who are not familiar with the new technology as a process of instruction. The research and development at Da Vinci Center should help remedy this situation. Basically, teachers do not have time to develop new technological applications or to wait for publishers to introduce systems packages (e.g., the inappropriateness of videodisc series that parallel textbooks). In fact, since publishers are far removed from classrooms, the new technological materials they introduce might not be useful in the clasrooms. One significant feature of the Da Vinci Center is that teachers will be free to write and produce curriculum incorporating new technology, not only for the Eugene Public Schools but for wider national distribution. Eugene teachers and educators from around the nation on an exchange-type program will rotate in and out of the Da Vinci Center.

International Council for Computers in Education (ICCE)

In addition to the above videodisc activities in Eugene, Oregon, the International Council

for Computers in Education (ICCE) is located at the University of Oregon and affiliated as a non-profit agency for educators using computers and publishers of *The Computing Teacher*. The author has done volunteer work with the ICCE and has organized a Special Interest Group for those persons interested in videodisc-microcomputer applications in education. This group, the Special Interest Group Videodisc-Microcomputer (SIGVIM), is well-established and publishes an ongoing newsletter. Persons interested in SIGVIM and who wish to receive the newsletter should contact: ICCE/SIGVIM, University of Oregon, 1787 Agate Street, Eugene, Oregon 97403-9905.

USING INTERACTIVE VIDEODISC IN THE K-12 CLASSROOM

Terence R. Cannings[1]

Introduction

Technology has no intrinsic value. It is what educators do with it that counts. It is not a panacea for solving educational problems, but it can support the learning process and give teachers another tool to use as they assist students reach their potential.

Videodiscs have been available to teachers for several years; however, the use of this technology in K-12 classrooms has been negligible. The reactions to and opinions of teachers who learned to use videodisc technology in order to ascertain reasons for its use/nonuse in classrooms are presented in this article. In addition, the importance of videodisc technology as perceived by these teachers, an ordering of ten factors which have contributed to nonuse, a summary of teachers' recommendations to a national task force to increase use, and some recommendations that will impact future classroom use are discussed in this article.

Background

The potential of interactive videodisc in the classroom has never been doubted. Harnessing the interactive power of the computer to the speed and image-storing capability of the videodisc provides a tool and a resource that can be utilized by every classroom teacher. However, applications and the use of interactive videodisc have mirrored those of the microcomputer. Like microcomputer software, interactive videodisc can be used as tutorials, for drill and practice exercises, for database activities, and for simulations or educational games. Teachers increasingly recognize the use of the microcomputer as an educational tool. They are using database programs, electronic spreadsheets, word processing, and problem-solving programs in their repertoire of teaching strategies. As teachers expand their knowledge of microcomputers and gain experience, the use of drill and practice software is decreasing.

The use of interactive videodisc should begin to reflect the same trend. Videodiscs are a database that students and teachers can access to support the curriculum teachers must implement. The videodisc is a tool that complements the teacher, the textbook, the ditto sheets, and the laboratory experiment. The videodisc is not intended as a substitute for any teacher or any learning strategy. But is the use of videodiscs common in elementary and secondary classrooms?

Despite the potential of videodisc technology, it has not been used extensively in schools. It appears many teachers and administrators are still coping with the microcomputer revolution, while still others do not possess sufficient microcomputers to allocate for specific use with the videodisc player. In addition, the additional cost of the player and the videodiscs appear to be reasons for the lack of use by teachers.

Purpose of the Study

The purpose for conducting the study reported in this article was to ascertain the reasons for use/nonuse of videodisc technology by surveying a group of teachers who had been introduced to interactive videodisc in a master's degree program. This sample of educators was also asked to list current and future uses, state the potential of this medium as an instructional tool, and make recommendations for future use that could be incorporated into a national agenda for the use of videodiscs in classrooms.

[1]The assistance of Nancy Strouse in the preparation of this paper is acknowledged.

Data Collection

The population for the study consisted of 130 graduates of the Master of Science in Educational Computing program at Pepperdine University. Responses were received from 80 graudates (62% response rate) during the summer of 1986. These students were introduced to videodisc technology, used it, reviewed videodiscs appropriate to education, and were able to use the VideoVision management system.

The survey instrument was sent to the graduates in July, 1986. It consisted of four sections: (1) current use/nonuse; (2) use of the technology in education; (4) reasons for nonuse in the classroom; and (4) recommendations for a national agenda for implementation.

Results

Position of Respondent

As can be seen from Table 1, most respondents were teachers, with a significant number responsible for instructional computing at their site or district level.

TABLE 1
Position of Respondent Involved in Videodisc Survey

Position	Number	(%)
K-12 teacher	46	58
College teacher	3	4
School coordinator	4	5
District coordinator	6	7
Resource specialist	7	9
Trainer, private industry	5	6
School administrator	3	4
Other	6	7
Totals	80	100

Use of Videodiscs

Only 17 (21%) of the sample had used a videodisc since graduation from a program in which they were introduced to videodisc technology. Further, only 10 (13%) had utilized the interactive capacity of this technology. The uses mentioned by the respondents were varied, as shown in Table 2.

TABLE 2
Reasons for Using Videodiscs Since Graduation

Reason	Frequency
Personal use	2
Demonstration on singing technique	1
Teacher demonstration	6
Testing products for classroom use	1
Use in classroom lesson	3
Testing for use in business training	1

N = 17

When asked to stipulate the disks used, respondents listed several different titles, as shown in Table 3.

TABLE 3
Titles of Videodiscs Used

Title	Frequency
Variety	1
Concert Disc	1
National Art Museum	3
Astronomy	1
Space Archives	2
Strong Kids, Safe Kids	1
Gardening at Home	1
History Disc Quiz	1
Van Gogh	1
Saturn	1
First National Kidisc	3
College USA	1

N=17

The highlights of these uses and demonstrations were: high motivation (3), quantity of information (1), access speed of information (2), classroom applications (2), quality of visuals/audio (4), ease of use (1), authoring systems (1), interactive mode (1), great potential for language arts teaching (1), and none--poor demonstration (1).

The respondents indicated various reasons for nonuse of videodiscs, as shown in Table 4.

TABLE 4
Reasons for Nonuse of Videodiscs

Factor	Frequency	(%)
No equipment available at district or school site	54	66
Cost of technology	10	12
Lack of subject area discs	7	9
Insufficient need	5	6
Lack of time to develop use	2	3
Ease of use	2	3
No training available	2	3
Teachers still coping with microcomputers	2	3
No suitable authoring system	1	1
Insufficient time to assemble equipment	1	1
Not accessible to my classroom	1	1
Totals	87*	108*

*Includes multiple responses

Obviously, videodiscs and players were in very short supply in most school districts. Some respondents were concerned about the cost of both the videodiscs and the players--a factor which publishers and manufacturers may need to consider if school teachers are to incorporate this technology into the instructional process.

Respondents also highlighted the need to produce videodiscs directly related to subject areas. As most secondary schools are departmentally organized in thought and deed, teachers relate to materials that impact directly their day-to-day classroom teaching needs. Typical comments included:

> They are not available in my district.
>
> No hardware at the school site.
>
> Hardware unavailable at this time.
>
> Videodisc technology is not available in my district yet.
>
> Not available in school district--expense of discs--lack of knowledge.
>
> Videodisc players are not available and not much educational material is available, at least not in business subjects.
>
> Schools do not have equipment and are just getting comfortable with computers--they are not ready for the next step.

Importance of Use

Twelve possible uses of videodisc technology were listed on the survey. Responses were asked to select one use or characteristic from the list that was the most important one to them. The results are shown in Table 5.

TABLE 5
The Most Important Uses/Characteristics of Videodisc Technology

Use/Characteristic	Frequency	(%)
Visual presentation	18	23
Simulation	16	20
Individual or small group use	12	15
Supplementing instruction	12	15
Data base	6	7
Teacher presentation	5	6
Audio/visual quality	4	5
Adding meaning to textbooks	2	3
All of the above	2	3
Tutorial	1	1
Teacher control	1	1
Two audio tracks	1	1
Totals	80	100

Many reasons were stated for selecting certain uses or characteristics of videodisc technology. Some of these include:

> Because one picture is worth a thousand words. The ability to add two audio tracks multiplies its worth.
>
> Giving students the opportunity to experience things they could not normally experience in the classroom setting.
>
> I feel the most appropriate classroom use is an archival source of photographs. A biology class can have all the photographs of cell division, fungi, ecosystems, etc.
>
> Visual presentations--the power of visual material to communicate is immense.

Ease of use and quality visuals.

Visual presentation--offers a more concrete method of teaching a concept than a teacher's lecture or teacher-made materials.

I feel that simulation is the most important because great learning takes place in true-to-life situations.

Data base--provides ability to highly customize presentations quickly. Interactive simulation would almost be impossible without this function.

Adding accurate simulations to teacher presentations. It would allow students to manipulate variables inappropriate applications to enhance understanding of theory.

Data bases--the ability to store vast amounts of material for easy access to learners and teachers.

All are applicable. The variety of uses is most important.

The most important factor is that the teacher has total control of speed, content, organization of the presentation. The quality of the visuals and audio is important because it is far superior to other available technologies. The ability to use two audio tracks allows the teacher to select the one which is the most appropriate for his or her students.

Visual presentations--to clarify concepts in science, social studies--goes far beyond texts, ordinary films.

Having discs that fit into existing curriculum and textbooks will faciliate the acceptance of this technology in the classroom.

Small group--videodiscs can be best used in small groups to stimulate small group interaction. This is more cost effective than individual use yet allows students to control pace and direction.

Reasons for Lack of Classroom Use

Respondents were asked to order a given set of reasons to explain their low incidence of classroom use. The reasons are listed in priority order in Table 6.

These responses indicate that teachers were unaware of the potential of interactive videodisc. Perhaps many teachers were still coping with the demands of the introduction of the microcomputer and its relevance to the classroom. Estimates of teacher use of technology are very disheartening, as displayed in the most recent Johns Hopkins University (1986) study. It appeared that approximately 20 percent of teachers in the study utilized technology's capabilities on a regular basis. How are the other 80 percent of the teachers reached?

TABLE 6
Rank Order of Reasons Given by Respondents for Classroom Nonuse

Order	Reason
1	Lack of knowledge of videodisc technology.
2	No support/interest/incentive from district office.
3	No time to develop applications.
4	Insufficient videodiscs.
5	Cost of videodiscs.
6	Cost of videodisc players.
7	Technology is too threatening.
8	Poorly designed interface between computer and player.
9	Poor authoring languages/systems
10	Not relevant to classroom instruction.

According to the survey, many teachers expected the district office to take a leadership role in promoting the use of this technology in the schools. This is not completely unexpected. School boards members, guided by district office personnel, appropriate funds for instructional support. If principals, superintendents, and district coordinators are not aware of this technology and its potential, it will not become a line item in the district budget. Few administrators will encourage teachers to reach for this new technology; lack

of support will not foster any experimentation or risk taking.

The third-ranked item, "No time to develop applications," is also not a surprising finding. Teachers have been trying to "cover" an overcrowded curriculum. Giving them extra duty or an additional task is asking too much of the average teacher. Similar findings have been reported elsewhere (Cannings, McManus, & McCall, 1985) in relation to the application of generic software programs to the instructional program in the secondary school. The intended applications, as reported in previous studies about technology in education, did not develop because teachers did not have time to research and develop new applications in their subject area. However, if teachers are given release time from the classroom, or some other incentive, some of these applications may develop.

Survey respondents were asked to give the reason they chose an item as their first selection of teacher nonuse of interactive videodisc technology. The following quotations are grouped according to the specific ranking.

Rank 1: *Lack of knowledge of videodisc technology.*

> The teachers at my school had not ever even heard of videodiscs.
>
> I don't believe many teachers know what a videodisc player is or how it can be used.
>
> Very few educators that I have talked with know anything about videos. Inservice workshops needed!
>
> Too many teachers do not update their skills--nor keep up with what is going on.
>
> Teachers in my district have not yet accepted the computer as a tool in the classroom.
>
> I feel at present there are few educators who are aware of laser videodiscs. Once the awareness level has passed, I believe more schools will be implementing the technology.
>
> Schools are just beginning to use computers on a mass basis. They are not yet open to the fact that the computer is the latest technology. I was recently asked to give an 8-hour inservice on computers in the Fall '86. When I begn to ask about the needs of the staff as a whole, I was given definite specifics. When I began to inquire as to whether they'd like to know about videodisc technology in relation to computers, the answer was a very polite "no."
>
> I feel most teachers are unaware of the potential of this new technology. Teachers will not begin to incorporate videodiscs into their curriculum until they have been exposed to their potential through workshops, inservice, etc.
>
> I don't think the majority of teachers understand the technology and its potential. I think this awareness can be enhanced with increased availability of educational discs.
>
> Teachers are constantly bombarded and overloaded with too much "new." They are not going to go out and seek anything else no matter how wonderful it might be.
>
> This is a new technology. Most people don't know about it or how to use it. Perhaps the manufacturers should place one in each school--as did Apple Computers, Inc.--to spark interest.

Rank 2. *No support/interest/incentive from district office.*

> The districts have a responsibility to research, present, and provide training for the teachers in sample lessons and use.
>
> District is still recovering from major computer investment ($8m). They will not listen to the next step yet.
>
> If the videodisc and player are not

purchased by state or district funds, then the teacher is not likely to purchase it on his or her own.

Our district has barely accepted computers and has done little to improve and coordinate it let alone try something new like videodiscs.

In my district there is no time or support for the teacher to learn about computers. Bring on videodisc and it's just one thing too many.

No knowledge at district level in use of this technology. There is no support for innovation originating down below.

Dollars! ! Lack of district long-range planning for implementation, training, and application.

District personnel seem to know or care nothing about this area of technology and what they can do to help students and teachers.

Rank 3: *No time to develop applications.*

Teachers can't work full time and be innovative in several other areas as well. The current push is still on computers. That takes time to train teachers and develop curriculum.

With any technology, time to learn to operate equipment is a major factor. It takes time to learn it and more to be able to use it well. Many teachers would love to use it, but the scheduling of time is nearly impossible.

Rank 4: *Insufficient videodiscs.*

Not enough applicable videodiscs to warrant the time and money spent on this technology.

They are just now being bought at some of our schools.

Not enough videodiscs means teachers will not use them.

Material is yet largely undeveloped.

Not many districts have videodiscs; therefore, teachers don't know about them and won't know how they can be used in their classrooms.

Teachers' time is valuable. Things must be simple to use, readily available, and broadly known in order to be accepted and used.

Recommendations to National Task Force

Respondents were asked to make three recommendations to a national task force charged with the development of a national agenda for consideration in the placement of videodisc technology in education. The responses are summarized in Table 7.

TABLE 7
Policy Recommendations to
National Task Force

Recommendation	Response Frequency
Grant funds/seed money	24
Inservice workshops/teacher training	22
Provide sample lessons/support materials/curriculum integration	21
Supply more videodiscs in subject areas	19
Provide plans/incentives for districts	14
Publicize	13
Disseminate material/demonstration tapes	7
Involve teachers/principal in process	7
Lower costs of videodiscs/players	7
Help teachers see potential	6
Create national catalogue/ratings of videodiscs	5
Equipment more user friendly	4
Develop library at district office	3
Videodiscs coordinated with textbooks	3
Not mandatory	2
Better authoring systems	2
Training as part of teaching credential	2
Madate through state legislation	1
It is not a panacea	1
Involve students	1
Establish a network	1
Develop incentive for producers	1

Examples of comments concerning the top five policy recommendations to the National Task Force are included:

1. *Grant funds/seed money*

Establish grant funds to encourage the use of interactive video technology.

Try to promote some program such as Apple Computer, Inc.did with their "Kids Can't Wait" program.

Grants to set up technology in some schools.

Encourage videodisc companies to "get into schools" like Apple and IBM did.

We need funds for equipment.

2. *Inservice workshops/teacher training*

More administrative/teacher workshops--not just at biannual conventions for those already interested.

Donate equipment, discs, and authoring programs to teacher training universities.

Require intensive training for all newly credentialized teachers.

Do not expect teachers to learn new technologies on their own time and at their own expense.

Staff inservice on this new technology is the most important first step. Nothing can be done unless the teacher knows it is out there.

Pick a cadre of teachers from the district--ask them to train others.

3. *Provice sample lessons/support materials/curriculum integration*

Provide written suggestions and plans for integration into the curriculum such as the TIC materials.

Make the technology easier for the average teacher--prepare interactive lessons and good manuals for classroom use.

Provide sample lessons which could allow the classroom teacher to become familiar with the technology along with how to use it in other curricular areas.

Provide useful, relevant, and appropriate examples of classroom use.

Allow teachers to use technology to create their own lessons and have ultimate control of curriculum materials--to be able to pick and choose lessons.

Concentrate on developing good sound material to go along with available resource material.

Provide beginning lesson plan programs.

4. *Supply more discs*

Develop more relevant discs that can easily be used in the classroom at an acceptable costs. Districts see $400-$500 and say no.

Develop practical, educational discs in the areas of history, English, and science.

Keep new discs focused on classical, traditional curriculum areas, e.g., biology, literature.

Provide assistance to companies making educational discs--especially in opening archives of films in areas of science and history.

Develop discs according to the appropriateness of the subject matter to educational objectives.

5. *Provide plans/incentives for districts*

Districts have a library of videodiscs available at a discount--discs that are appropriate to the district's curriculum.

Provide incentives for districts to use interactive video.

Educate administrators.

Develop a library of videodiscs in each school, and encourage the use of them.

Conclusions

From the survey of 80 educators in the Los Angeles area the following conclusions appear warranted:

1. Few teachers or instructors were using interactive videodiscs in the classroom.

2. The major reason cited for nonuse was the lack of equipment available at the district or school building level.

3. Several uses/characteristics of interactive videodiscs were important to current and future users. The quality of the visual and audio characteristics and the ability to use this medium for visual presentations were ranked very high.

4. The respondents perceived that a general lack of knowledge of videodiscs by other teachers was responsible for the lack of use in classrooms. They also perceived that district office personnel shared this lack of knowledge and offered no support or interest in using the technology. Thirdly, the respondents perceived that teachers did not have time to develop classroom applications.

5. Of the many recommendations made to a national task force, providing seed monies and grant funds and increasing teacher training courses were considered essential to increasing teacher use. Likewise, producing sample lessons and support materials for curriculum integration were seen as necessary if interactive videodisc is to reach its potential as a learning/teaching tool in the classrooms.

Recommendations

1. *Increase awareness.*

Videodisc technology cannot be widely used if teachers do not know it exists! But how does a publisher increase awareness of videodisc techology? A few suggested strategies are listed below:

a. Show how videodiscs can be used to support classroom instruction at national conferences such as ASCD and ACSA, where teachers and administrators attend in great numbers.

b. Popular teacher journals should include articles on the use of this technology in specific subject areas. Teachers read materials related to their grade levels and subject area expertise.

c. Produce videodiscs that can be sold with a teacher's manual accompanying the textbook.

d. Use some political pressure to incorporate videodiscs in state-supported and mandated curriculum frameworks.

e. Encourage a manufacturer to promote a give-away program similar to the Apple Computer, Inc., philanthropic strategy in California.

f. Sell videodisc players at discounts to teachers provided they produce two application modules for their subject area.

g. Compact disc players are becoming known as an entertainment medium. Utilize this familiarity with the technology to promote the use of videodiscs in classrooms.

2. *Manufacture user-friendly devices.*

Nothing will turn teachers away from this technology more than continued frustration with the equipment. If the interface fails on three occasions, the teachers will likely not try it again, no matter what promises are made.

The technology must be easy to assemble and even easier to operate. Watching an interactive videodisc demonstration in which the vendor takes 20 minutes to align cables with machines will deter most teachers even before the presentation begins.

The interface unit for Level 3 applications must be durable enough to sustain movement of the equipment between classes. In many cases, teachers will share the equipment necessitating frequent movement, possibly on a cart. If terminals become lose and connections part, use will decrease even after repair.

3. *More videodiscs.*

Many teachers complain that few videodiscs are available in their particular subject area. Rather than produce videodiscs of a general nature, publishers may need to align uses within particular subjects. Some of the more recently produced discs in the areas of biology, astonomy, social science, science, art, and music have fallen into this pattern. Teachers approach the use of technology within subject boundaries. Videodisc producers must do likewise and select subjects such as social studies, science, visual arts, and language development for particular emphasis. However, it is important not to forget the elementary school classroom!

4. *Cost of players, videodiscs, and interfaces.*

The cost of the hardware and software is decreasing. Players that cost $800 two years ago can now be purchased for $400. This trend must continue as, unfortunately, many administrators compare videodisc player prices with those of VCR's.

Similarly, the cost of videodiscs must be lower than current prices. There is a feeling in the education community that $400-$500 is too much for one disc. Educators are not accustomed to spending that kind of money on one disc. Perhaps videodiscs can be sold in "packages" at drastically reduced prices. Obviously, this creates a problem for the publisher who must recoup development and production costs.

Not all states have the luxury of using lottery money to buy hardware and software. It can be predicted that unless the prices of videodiscs and players decrease even further, they will not be attractive, on economic grounds, to many administrators.

The cost of interface devices is now within the realm of most district budgets. However, it is not the cost but the reliability of the interfaces that creates problems for the videodisc industry.

5. *Videodiscs aligned to textbooks and state curriculum frameworks.*

One of the most important factors for selecting discs for future production will be the ability to support basic curriculum objectives taught in typical schools--a curriculum which is based on subject objectives as portrayed in textbooks.

Most schools are likely to continue using some form of textbook-based instruction because textbooks, according to some superintendents, appear to decrease curriculum development expenditures and reduce the need for inservice and support personnel. In addition, textbooks are an integral part of long-standing cultural patterns in the United States. Schools are not likely to adopt programs that do not serve their textbook-based curriculum objectives or supplement current materials.

To respond realistically to this tendency of most schools to continue with textbooks and buy supplementary materials where appropriate, videodiscs must be produced for compatibility with relevant chapters in all widely used textbooks and the curriculum objectives in typical school districts.

6. *Instructional modules.*

Aligning videodiscs to curriculum frameworks and commonly used textbooks is the first step. The production of instructional modules to assist teachers in the classroom is the second.

Developing applications for videodiscs is no easy task. It takes time and energy, to say nothing of expertise, to develop uses within and across subject areas. Teachers need support in the classroom. One way of providing this support is to produce instructional modules containing: goals and objectives, materials required, target groups, prerequistie skills, learning activities, and assessment procedures.

We need more instructional modules that are aligned to textbooks, to promote the use of interactive videodiscs in the classrooms. Such an effort could be coordinated across state boundaries. Who will take charge?

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USING VIDEODISC PROGRAMS ON 'UNDERSTANDING GROUPS' IN A UNIVERSITY SETTING

Dennis R. Falk and Helen L. Carlson

Introduction

Staff members from the College of Education and Human Service Professions at the University of Minnesota, Duluth have undertaken an ambitious project to develop a variety of videodisc programs to be incorporated into the core curriculum of the university. *Understanding Groups* is the initial curriculum disc of the series. The background, nature, and uses of the *Understanding Groups* videodisc is described in this article. The research and evaluation activities associated with the discs and what was learned about developing and using discs in a university setting are also discussed in this article.

The *Understanding Groups* Videodisc

Understanding Groups is the first of twenty-one videodisc programs scheduled to be developed at the Center for Advancement of Learning Technologies and used in the College of Education and Human Service Professions. The current program and subsequent discs will be used as part of the undergraduate core curriculum in the college and for inservice education for teachers and other human service professionals. *Understanding Groups* is one of seven discs in a series called *Creating Healthy Human Systems*. Other discs in this series will focus on understanding and effective intervention with other social systems, including the individual, the family, organizations, communities, and society. Two other series of seven discs will focus on developing helping skills and on research and statistical competencies necessary for teachers and other human service professionals.

The *Understanding Groups* program contains full modules on shared leadership, group goals and goal structures, group communication, and conflict resolution in groups. Group decision making, power in groups, and leadership styles are more briefly covered in an additional module. Included in each major module are a pretest providing feedback to students on how they may most effectively go through the module, an instruction section which introduces key concepts, and a practice section which allows the learner to use the new concepts. Students learn about group behavior through observation of a small group in a collegiate class, a parent education group, a cooperative learning group in an elementary school, an adolescent drug treatment group, and a senior citizen advisory board. In each application section, the learner applies new ideas in a simulated group setting through serving as a member of a search committee hiring a director in a human service agency.

Based on an extensive learner analysis, in which it was indicated students preferred to learn about groups in different ways, both inductive and deductive tracks were included in the instruction and practice sections. The inductive track allows students to view video segments of group behavior and develop their own theories about the dynamics in the group before receiving an "expert explanation," later comparing their own ideas to those of the expert. The deductive track presents the key concepts and definitions and uses video segments of group behavior as an example of the concept.

The videodisc is the central part of an integrated learning package. A learner manual includes worksheets to assist the students in observing segments of group behavoir, key definitions, and other information related to groups. The instructor manual includes alternative ideas for using the disc, group exercises which can be completed in the classroom to provide direct experience using the concepts presented in the disc, and a final evaluation which can be used in conjunction

with the videodisc. Approximately two hours of videotapes of four different groups are also available so that students and instructors can have additional examples of a variety of group behaviors.

Research and Evaluation

A key research component of the current project was the front-end analysis conducted in preparation for designing *Understanding Groups*. This process included learner analyses and subject-matter expert interviews. Over 100 undergraduate and graduate students were surveyed to determine the extent of their knowledge of group dynamics and the style of learning which best facilitaited their learning. The separate inductive and deductive learning tracks were based on the results of this survey. Fifteen college faculty members and human service practitioners were interviwed as subject-matter experts to determine the most important topics and best forms of instruction to be used in the videodisc. Areas of content included such topics as task and maintenance functions, communication networks, cooperative and competitive goal structures, and problem solving in conflict situations.

Two types of evaluation were undertaken to improve and study the effectiveness of the disc. The first type of research was formative evaluation, that is, field testing the disc program to determine how the quality and effectiveness of the disc could be improved. During spring quarter of 1986, approximately thirty undergraduate students and ten faculty members completed all or parts of the disc; the students and faculty members identified strengths, such as the attractiveness of observing actual group interaction, and weaknesses, such as the need to specify directions for using the manual. After editing, this type of evaluation continued for the 1986-87 academic year with larger populations of students and faculty.

The second type of research undertaken was summative evaluation, that is, determining how effective the disc program was in helping students to achieve instructional goals. The initial research involved a random assignment of students to either an experimental or control group. The experimental group used the disc as its primary source of information on groups; the control group was exposed to information by more traditional lecture and discussion formats. The research focused on the differences between experimental and control groups on criteria such as satisfaction with the learning process, acquisition of knowledge, and group observation skills. The effects of the inductive and deductive learning tracks on observation and group facilitation skills were also examined.

Advantages and Disadvantages of Videodisc Development in a University Setting

Two prerequisites to the development of videodiscs in a university setting are administrative support and a cadre of enthusiastic and trained individuals capable of working as a team on a complicated project. The Dean of the College, who initiated the current videodisc development activities, removed bureaucratic barriers and secured funding from a variety of sources. Additionally, the chief academic officers at the University of Minnesota, Duluth have been supportive of the project since its initiation in May of 1985. The Videodisc Research Group was self-selected among college faculty members, and all members had an opportunity to participate in the Nebraska Videodisc Workshop in order to develop necessary skills related to videodisc development.

Funding, human resources, and physical plant resources are three areas in which the university setting offers both advantages and disadvantages. The university can potentially attract external funding from corporations, foundations, and professionals organizations. For example, the College of Education and Human Service Professions at the University of Minnesota, Duluth, received approximately $400,000 from the Digital Equipment Corporation for IVIS videodisc equipment and a $350,000 grant from the McKnight Foundation to underwrite the cost of development and research on videodiscs related to helping skills in the human service professions. In contrast to the external funds, internal funding for clerical assistance and

production and mastering costs was more difficult to obtain during a period of declining resources in higher education.

Human resources are often plentiful and varied in the university. Many faculty members are familiar with instructional design and computer programming. Subject-matter experts, video production specialists, and persons with administrative skills are usually present. In contrast, the bureaucratic nature of the university often segregates its faculty and staff in a tight departmental structure. Much effort was expended in order to obtain seven faculty members from five different departments, the computer center staff, and the production staff on the Minneapolis campus (150 miles to the south) to work cooperatively on the project with personnel at the Duluth campus.

Physical plant resources are a third area of consideration. University settings often provide computer facilities, including both micro and mainframe computers and computer networks. Media production studios are often available for the development of instructional materials. However, difficulties have arisen within the project on the Duluth campus due to the maintenance of physical resources and updating of production facilities.

Conclusion

The Videodisc Research Group members have found that it is possible to develop worthwhile videodisc projects in a university setting. Since May of 1985, the group has completed two videodisc projects; in addition nearly all of the programming on two additional disc projects is completed and a fifth videodisc is in the design phase. Group members have begun to publish working papers related to all phases of videodisc development and to make presentations at regional and national meetings.

A strength of designing and producing videodiscs in a university setting is the research expertise and motivation that is present. Strengths, such as varied human and physical resources, can be built upon in university development projects; however budgetary and bureaucratic limitations must be overcome.

Videodisc Research Group members believe universities can be effective designers and producers of interactive videodisc; they can also provide unique laboratories for the use and evaluation of videodisc programs.

A FRAME OF REFERENCE FOR THE USE OF VIDEODISC TECHNOLOGY IN PUBLIC EDUCATION

Alan M. Hofmeister

If videodisc technology is to make a substantive contribution to public education, videodisc product developers must recognize the unique needs, strengths, and research history of public education. The following concepts are presented to guide such an approach in the application of videodisc technology to the problems of public education.

1. The instructional information bases used in videodisc technology should stress the capturing, preservation, and dissemination of the practices of master teachers. Too often, videodisc programs use shallow "systems" recipes left over from the days of programmed instruction. The research literature on the characteristics of effective classroom teachers would make a better reference point for a theoretical base. The input of a few talented and experienced master teachers who understand (1) the most prevalent misconcepts, (2) the critical prerequisite skills, and (3) the instructional sequences and presentations most motivating for public school students is extremely important. All the backroom task analyses by instructional design experts cannot provide such important normative information on the learner populations.

2. There should be adherence to the basic requirements of instructional product validation. Those validation requirements that relate to prototype field testing and revision to ensure specific outcomes can be obtained within specific public school populations are most important. Videodiscs are being released for school use with no substantive learner validation data. The fact that prototype testing and revision are cumbersome, time consuming, and expensive is no excuse for such serious omissions in such an important endeavor.

3. The research history of instructional product design in public education should be recognized through videodisc programs. Too often, a predetermined solution is pushed regardless of previous findings with similar approaches. There is extensive research to suggest that instant feedback has little advantage over delayed feedback. There is also extensive research indicating that individual instructional settings may actually be no more effective than the less expensive, small and large-group settings. Given this extensive research base, one must wonder about those who advocate only the Level 3 videodisc because it provides individual and instant feedback.

4. The reality of resources and budgets of public schools should be recognized through videodisc development. Too often, technological solutions costing dollars per student hour are being advocated for a system which can only afford interventions that cost less than 10 cents per student hour. To suggest that persons persevere with such expensive interventions, because "the day will soon come when we will be able to afford it," ignores the fact that the cost of technology is not dropping that fast; such reasoning restricts the search for alternative solutions that can be effective with the resources presently available.

5. The unique aspects of public school instruction should be recognized through videodisc development. For example, technological solutions borrowed from industry will not always recognize the central role of the teacher in the public school classroom. For many administrators, staff development is just as important as student achievement. An instructional product that enhances both the skills of the teacher and the skills of the student within the same cost structure may be twice as valuable as a product that makes the teacher an equipment operator and does little to enhance the teacher's knowledge of effective instruction in the specific subject area. The flexibility of videodisc technology is one of its greatest strengths. Such flexibility should be used to ensure the videodisc programs are adapted to

the needs of public education. The unmodified transfer of programs or theoretical approaches from other areas to the public schools does a disservice to the technology and public education.

6. It should be remembered that no technological approach is inherently superior. Each individual product must be validated for a specific application. However, once a specific cost effective application has been validated, its greatest contribution is the facility for replication. The implications for product developers in public education is clear: Interested persons must be prepared to make large investments at the front end and ensure a high-quality, reasonably priced product is available for the consumer with limited resources.

SECTION IV

THE NATIONAL AGENDA FOR 1986-1987

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CONCLUDING REMARKS

John Prasch

This has been a *quality* conference. There were quality presentations. Each presenter provided both practical and visionary ideas that stimulated debate among the participants throughout the conference.

Although many of us initially felt perhaps we had set a goal that was too ambitious and somewhat presumptious, I am now persuaded that the impact of the several days together might extend much further than persons had hoped.

To be sure, it was discovered when we sat down to develop a national plan that consensus was difficult to achieve. However, it was also discovered that consensus was difficult, not because the participants did not have a common goal, but because the participants had wide and varying backgrounds of knowledge and experience. There was an openness of dialogue that encouraged substantive but friendly and productive disagreement, and we took heart in the knowledge that this is the crucible from which all significant statements are born.

In terms of consensus, the one prevailing thread heard repeatedly was the hope that something more than just another report or a set of recommendations would come of this conference. Your Task Force has attempted to respond to that hope.

The truth of the matter is that a routine reporting back to you of the work of the Task Force will be inadequate. I would have to be a poet, a singer, or a dramatist--or at least a more impassioned speaker than I am--to transmit to you the electrically charged enthusiasm that characterized the meeting of the Task Force.

A matter-of-fact report may not suffice because, if the action you so persistently demanded will take place, it depends on your continued involvement and your enthusiasm to make sure it happens. None of us should underestimate the power in this assembled group. We were fortunate to have at the conference a good mix of the key constituent groups that together can move videodisc applications forward. Because your continued involvement is the key, the Task Force struggled mightily with the question of how best to tap the resources of this group in a continuous and meaningful way. Therefore, the essence of our planning is to provide the process by which each of you can further the work of the conference wherever you go. Whoever said, "think globally but act locally" caught the meaning of our message.

It was only when the Task Force began thinking in terms of each of you as a multiplier that we could turn away from the unproductive complaint that it was difficult to synthesize what you had said to the more productive search for what needs to be done next.

You cautioned us at many points against coming up with a slick and final national plan to be laid on an unsuspecting audience. It was also obvious you did not have time to say everything you wanted. And, although documents will be produced, the thought that a final and finished statement could be presented is not in keeping with the dynamic nature of the subject.

You will, therefore, be mailed a dressed up and edited version of the document that has come from our deliberations thus far. This will serve as a preliminary report of the conference. Your responsibility will be to respond to that draft, to share it with your colleagues, and to use it as a basis of discussions in your local arena and in your organizations. Your response will be important so that first efforts can evolve into a more formal and comprehensive statement. The more formal statement must be legitimized by your continued dialogue with a larger audience. In that connection, the people who were not at the conference may be as important as those who were. It becomes the responsibility of each of us to expand this network to include all those with an interest

and expertise in the use of videodisc technology in the schools. Let us know who those key people are so material can be sent to them as well.

The initial statement will indeed identify some common ground that came from our discussions. The following key phrases suggest some of the areas of agreements:

Need for teacher training
Evaluation of instructional designs
Communication and dissemination procedures
Not a panacea
Broaden the representation (i.e., textbook persons)
There is great potential

The Task Force has committed itself to staging a full-day national teleconference as a follow-up of this meeting to help create awareness and understanding of videodisc technology. With the important cooperation of the National School Boards Association and the various institutions, consortiums, and businesses represented here, members of the Task Force believe there is a huge potential audience for such a teleconference. To deliver that audience, however, will require the work of each of you. You may help with programming as well.

Task Force members need your contributions of all kinds. Enough issues have been raised at this conference to suggest the need to write important papers, start projects, and begin meaningful research. You have called for a clearing house, so do not hide your work. John Rogers of the Task Force has agreed to be the person to whom written contributions should be sent. Write a paper, make a videotape, tell us what you are doing. It does not need to be a formal statistical report.

The Task Force formed at this conference will meet formally at the time of the NECC Conference in Philadelphia. In addition to assembling a final document resulting from the conference, Task Force members will act as jurors in selecting the best work produced as a prelude to the Second Annual Conference, now scheduled for October 5-8, 1987, in connection with the Videodisc Producers Symposium.

Members of a subgroup of the Task Force are examining the possibility of developing an electronic mail network devoted to the exchange of information on our topic of interest. Steps are being taken to expand an existing newsletter to increase our communication potential.

In short, the conference has created momentum, and important initiatives are in motion. So that you will know whom to contact, the teleconference is being planned by Ron Nugent and Dennis Kulvichi. Your written contributions should go to John Rogers. Ward Sybouts and Dorothy Jo Stevens are authoring the preliminary report. Tom Burnett will arrange a program at NECC. Phil Kessinger, Mike Liebhold, and Richard Pollack are examining electronic mail.

RECOMMENDATIONS FOR A NATIONAL AGENDA FOR THE IMPLEMENTATION OF VIDEODISC AND LASER TECHNOLOGY IN EDUCATION

Recommendations for a planning process to implement videodisc techology into education are based upon the following assumptions:

- Videodisc technology has the potential to be a valuable instructional tool because of its capacity to access and deliver an extraordinary amount of material on a wide range of topics.
- Videodisc technology will become increasingly common and could have a significant impact upon education.
- The videodisc, as well as other forms of technology that can be utilized in education, will continue to evolve, thus requiring constant change on the part of educators in order to make judicious applications of new forms of technology for the benefit of learners.
- Educators need assistance to facilitate the effective adoption and evaluation of videodisc technology in the classroom. Concurrently, practitioners need to be involved in the planning, research, and development of videodisc applications for instruction.
- Because of the nature of videodisc technology and its interdependence with other forms of technology, such as computers or television, the adoption process should be carefully planned.
- Evaluation of the videodisc as a form of technology used for instruction will be essential.
- Since videodisc technology has not been widely adopted by educators, a clear need exists for continued research and development work.
- Cooperative ventures should be established between and among leaders in education, industry, and the public sector.
- Sufficient traffic in the marketplace for industry to be able to respond to the needs of educators will be generated only through the purchase of videodisc software and hardware and putting these materials to use.

GOALS AND OBJECTIVE

Recommendation 1: Support the continuation of a national task force, representative of all segments of education and commercial interests to foster and promote videodisc technology in education. Such an advocacy group could provide direction and focus through various efforts.

1.1 Encourage the development and clarification of policy and direction for videodisc technology in education.

1.2 Provide a mechanism for involving leaders from all relevant segments in society to determine goals and priorities.

1.3 Foster developmental activities and communication networks.

1.4 Provide leaders at the regional and national levels with an information base as they develop goals and priorities.

NEEDS ASSESSMENT

Recommendation 2: Promote a broad base of understanding of educational uses of videodiscs.

2.1 Disseminate information to the membership of all groups that will have a vested interest in videodisc technology, i.e.,
- Teachers
- School library media specialists
- Personnel in higher education and non-traditional educational settings
- Leaders in funding agencies, both public and private
- Educational administrators
- Vendors
- Audiovisual producers
- Computer and videodisc software producers
- Leaders in private educational agencies
- Politicians
- Public television personnel
- State departments of education personnel

2.2 Foster the compilation and dissemination of relevant research.

2.3 Encourage continued research efforts and disseminate information about needs.

2.4 Explore the needs for networking and the fostering of networks to disseminate information.

EVALUATION AND RESEARCH

Recommendation 3: Encourage and promote research and evaluation at all levels of implementation to determine appropriate practices and to ascertain the effectiveness of videodisc technology for education.

3.1 Conduct validation studies of videodisc software and applications regarding (1) learning theory, (2) instructional design, (3) teaching models, (4) curriculum development, and (5) knowledge about software production.

3.2 Encourage evaluation in which questions are addressed regarding videodisc technology and how students learn factual materials, how it influences their attitudes, and its effectiveness as an instructional tool for higher-order thinking skills.

3.3 Evaluation of how videodisc technology is used and how well students and instructors accept it will also be needed.

PROCEDURES AND PROCESS

Recommendation 4: Develop a mechanism to communicate the potential and appropriate use of videodisc technology in education.

4.1 Promote publication of more articles in national journals emphasizing videodisc as an educational tool.

4.2 Establish a national clearinghouse for information about videodisc technology for educational use.

4.3 Develop demonstration materials, such as a sampler, for showing educators the nature and potential of videodisc technology in education.

4.4 Encourage the dissemination of an annotated catalog of materials from validation studies about the quality and applicability of videodisc software.

4.5 Establish user networks supported by electronic bulletin boards and electronic mail to share ideas.

4.6 Provide information about exemplary programs found in local schools.

4.7 Establish a sharing library of videodisc materials and catalogs.

Recommendation 5: Encourage cooperative working relationships between industry and education as common goals

and needs are identified and solutions sought.

5.1 Identify educational consumer needs for industry.

5.2 Encourage hardware and software compatibility.

5.3 Foster a flow of information between specialists in education and developers of software.

5.4 Encourage representatives from commercial and production segments, working with educators, to address the issue of obsolescence, research, development, and the support of funding agencies.

Recommendation 6: Promote the training of educators.

6.1 Develop videodisc materials specifically for training users.

6.2 Promote training targeted at preservice and inservice audiences, as well as materials for trainers of teachers.

6.3 Encourage creative and flexible uses of the videodisc with accompanying evaluation efforts.

6.4 Plan for immediate and short-range training needs, as well as ongoing, long-range staff development for users in K-12 settings, higher educational institutions, and nontraditional education.

6.5 Encourage local leaders to provide resources for staff inservice at the local level that will involve implementation and evaluation procedures; these resources should include time, space, software, hardware, and consultation.

6.6 Sponsor or encourage curriculum development or revision efforts and the sharing of resources through networks so that efforts in research and development are not duplicated.

Recommendation 7: Integrate videodisc programs with existing curriculum materials. When integrating videodisc with other forms of instructional materials, there should be an effort to complement and enrich the current curriculum.

7.1 Determine appropriate uses of videodisc materials through experimentation and field testing.

7.2 Select hardware and software to meet the needs of the curriculum.

7.3 Develop lists of retrievable objectives and appropriate test items that correlate with videodisc materials.

7.4 Coordinate content of texts with videodisc materials.

7.5 Recognize the differences in using the videodisc for the training of skills in a narrow sense as contrasted to contributions in the development of critical thinking.

7.6 Design videodiscs specifically for teacher training.

7.7 Recognize legal requirements and policies regarding copyrights.

7.8 Develop a process for the assessment of videodisc materials that takes into account criteria reflecting learning theory, content, technical quality, and instructional design standards.

7.9 Coordinate content of videodiscs with state department of education requirements.

EQUITY ISSUES

Recommendation 8: Recognize and plan to accommodate issues relating to equity.

8.1 Provide assurances all groups of learners will have equal and adequate access to videodisc technology.

8.2 Encourage the development of videodisc materials that address the needs of students with exceptional needs and different ethnic and socioeconomic backgrounds. Such materials should avoid the promotion of stereotyped behavior based on race or sex.

FUTURE PLANNING

Recommendation 9: Continue to foster and emphasize planning for the use of videodisc programs in education, based on evaluation and research findings, that demonstrates vision, courage, and strength.

9.1 Anticipate second-order effects of implementing videodisc technology. (The second order effects of the automobile resulted in the development of the service station industry and the expansion of the entire oil industry, as well as contributing to urban sprawl and levels of mobility in society. It may be expected there will be second order effects of high technology in education.)

9.2 Conduct a national symposium each year to evaluate the progress of the adoption of the videodisc technology in education.

9.3 Plan for and develop linkages with potential users of videodisc technology, such as art galleries and state agencies fostering tourism.

9.4 Seek funding sources for the development, testing, and implementation of videodisc technology in education.

9.5 Plan for the development of programs to educate the public about videodisc technology in education.

SECOND ANNUAL VIDEODISC SYMPOSIUM FOR EDUCATORS: IMPLEMENTATION OF THE AGENDA

The Second Annual Videodisc Symposium for Educators: Implementation of the Agenda will be held in conjunction with The Eighth Annual Videodisc Symposium on October 5-8, 1987, Lincoln, Nebraska. This joint effort combines the expertise from a broad base of knowledge, development, experience, and applications of videodisc technology. The special portion for educators will focus on "Education: Discoveries & Decisions." The goal of the symposium for educators will be to determine a Plan for the Educational Implementation of Videodiscs.

The two-faceted symposium is designed for both videodisc producers and educators who make use of videodisc technology in instruction. The dual event is intended to provide an interdisciplianry forum wherein educators, videodisc producers, and exhibitors can come together to share ideas, expertise, and state-of-the-art videodisc programs.

Some sessions will be concurrent and others will be "break-away" segments, enabling educators to attend those sessions of specific interest to them. Special effort will be made to allow educators to formulate an implementation plan that will take advantage of and build upon the National Agenda recommendations.

At the joint symposium, leading videodisc educators, designers, and producers from across the country, chosen for their innovative work in the videodisc field, will demonstrate their projects, share design and production techniques, and discuss current research and development efforts, as well as implications and applications of videodisc technology for the future.

During the education "break-away" sessions, educators who are successfully using the medium in outstanding or innovative ways will share their experiences and recommendations.

Throughout the symposium, efforts will be made to raise the consciousness and enhance the expertise of primary and secondary school, college and university educators, and others about the potential of videodisc technology as an educational tool.

Additional features for this Eighth Annual Symposium are the videodisc and library marketplaces, commercial exhibits, and presentation of the 1987 Nebraska Interactive Videodisc Awards.

The joint symposium for producers and educators is being sponsored by two University of Nebraska-Lincoln (UNL) agencies: the Nebraska Videodisc Design/Production Group and the Teacher's College. The UNL Division of Continuing Studies and the National Association of School Boards are also cooperating.

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